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ABSTRACT

These proceedings address the appropriate uses of technology in education, including papers and summaries of presentations on the following topics: community partnerships; desktop publishing; English as a Second Language/English to Speakers of Other Languages (ESL/ESOL); cognitive issues in multimedia; higher education applications; social studies K-12; distance learning-media centers; business and vocational education; hypermedia and multimedia in education; restructured schools; technology-supported writing; media tools for special needs students; Texas Center for Educational Technology; science/mathematics K-12; telecommunications; tools for special students in regular classrooms; planning and curriculum; computer literacy/science; tools for teachers; classroom activities for students with special needs; at-risk students; restructuring ideas; developing cognitive skills; special needs; international perspectives; teaching with interactive video; technology for students with learning disabilities; language arts; distance learning; art and music; supercomputing; networking environments; gender equity issues; approaches in problem solving; technology training for special educators; keyboarding-writing in the elementary school; Logo applications; hypermedia; science and multimedia; technology in teacher education; telecommunications in the elementary classroom; staff development; and multi/hypermedia: K-12. In addition, the conference proceedings contain sections on NECC '92 conference committees; society descriptions; poster sessions; and session presiders. (ALF)

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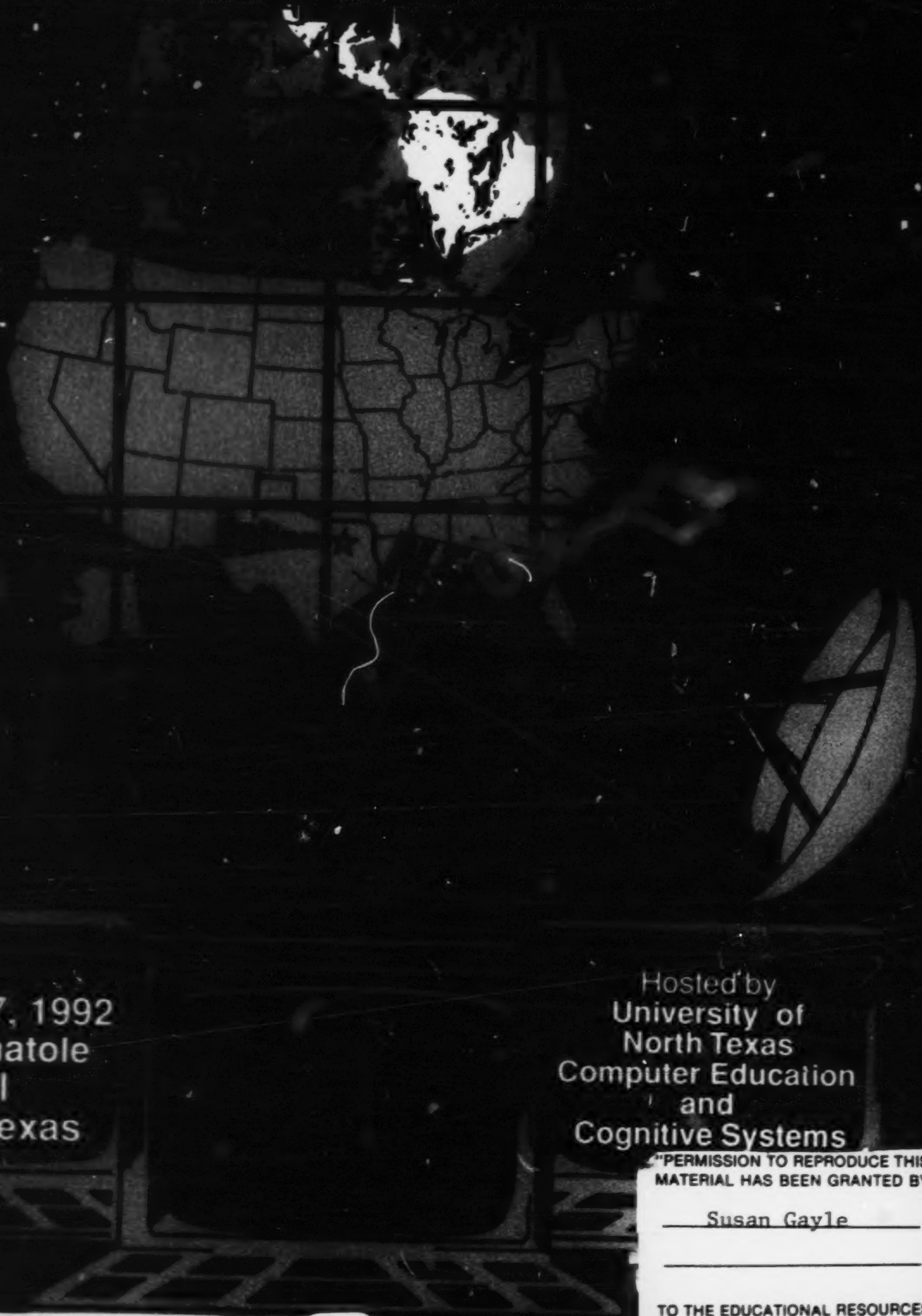

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PROCEEDINGS

Susan Gayle, Editor

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Foreword

Welcome to NECC '92

NECC '92 is the thirteenth annual National Educational Computing Conference, and while it may initially have been a national conference, its scope has now extended throughout the world. Each year the number of national and international participants increases, with the appropriate use of technology for education as their common goal. As the needs of this diverse population continue to expand, so do the technological advances and applications necessary to satisfy these needs.

The theme of NECC '92 "Windows to the World" is an attempt on the part of the Conference Committee to present windows which have been opened through technology, and the new technological worlds that we may experience are not just geographic locations. Rather, they represent the wealth of opportunities for students to examine basic theories and concepts, to explore new frontiers, to extrapolate and extend information, and to extract what is meaningful to them as individuals. The current technology can empower students to look through, open, or climb through any window to any world.

These Proceedings are intended to serve as a reminder of the conference sessions you were able to attend, and perhaps as food for thought, or maybe just an "FYI" of the sessions that would not fit into your schedule. It is our hope that you will also use the Proceedings while you are attending NECC '92 to help plan your daily agenda. The papers presented at the conference are printed in their entirety in this volume, whereas there are only abstracts of the project sessions and special presentations.

It should go without saying that NECC '92 could not be what it is without the extraordinary efforts and untold hours of work on the part of the dedicated volunteers who are an integral part of NECC. For the miracles they performed, I thank them.

On behalf of the entire NECC '92 Conference Committee, we hope that we have provided you, members of the educational community, with the tools necessary to design future learning environments that are full of windows to the world.

Cathleen A. Norris, NECC '92 Conference Chair
University of North Texas
Denton, Texas

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Cooperating Societies

ACH–
Association for Computers and the Humanities

ACM–
Association for Computing Machinery

ACM/SIGCAS–
Computers and Society

ACM/SIGCSE–
Computer Science Education

ACM/SIGCUE–
Computer Uses in Education

ACM/SIGUCCS–
University and College Computer Services

AECT–
Association for Educational Communications and Technology

ASCUE–
Association for Small Computer Users in Education

CCSC–
Consortium for Computing in Small Colleges

ECMI–
Educational Computing at Minority Institutions

EDUCOM

IEEE-CS–
IEEE Computer Society

ISTE–
International Society for Technology in Education

ISTE's SIGTC–
Special Interest Group for Technology Coordinators

SCS–
Society for Computer Simulation

Society Descriptions

ACH—Association for Computers and the Humanities

The Association for Computers and the Humanities (ACH) is an international organization devoted to encouraging the development and use of computing techniques in humanities research and education. Traditionally, ACH has fostered computer-aided research in literature and language, history, philosophy, anthropology, and related social sciences as well as computer use in the creation and study of art, music, and dance. As computing applications in the humanities have developed and broadened in the 1980s, the Association has expanded it scope to include areas from word processing to computer-assisted instruction in composition, language, history, philosophy, and anthropology, as well as computational linguistics and cognitive science, which overlap increasingly with work in the area of humanities computing.

Founded in 1977, ACH is the primary professional society for humanists who are involved or interested in any aspect of humanities computing. The Association provides a forum for continuing communication about humanities computing and strives to meet the needs of those who want to gain familiarity with both existing and potential applications of computers in humanities disciplines.

The heart of ACH is its quarterly newsletter, which covers the activities of the Association and its members and includes articles on various areas within humanities computing, news of projects and conferences of interest to ACH members, and reports on activities of governmental agencies and other organizations that affect computer-aided humanities research.

Computers and the Humanities, published by Paradigm Press, is a quarterly journal devoted to scholarship in the field of humanities computing. Subscription to *CHum* is included in the ACH membership fee.

ACH sponsors the biannual International Conference on Computers and the Humanities (ICCH), held in odd-numbered years, which brings together scholars from around the word to report on research activities and software and hardware developments in the field. Recently, ACH began to sponsor conferences and workshops on specialized topics in humanities computing, held in even-numbered years.

SIGCAS—ACM Special Interest Group on Computers and Society

SIGCAS is the Association for Computing Machinery's Special Interest Group on Computers and Society. With a membership of nearly 1,200, this professional group seeks to identify social issues raised by computer technology and to provide a forum for discussion on how to approach these issues.

SIGCAS publishes a quarterly newsletter, *Computers and Society*, which is a primary source of material on this topic. As a vehicle of communication for the SIGCAS membership, it includes news, comments, and articles on any societal issues raised by computing technology. One of the few periodicals on this subject, it provides a flexible and timely forum for important, evolving topics, such as data quality, employment, and intellectual property rights.

According to a recent membership survey, about 40% of SIGCAS members teach course material on computers and society. In recent years SIGCAS has organized sessions at computer conferences on topics such as computer ethics and organizational impacts of computers.

SIGCSE—ACM Special Interest Group on Computer Science Education

SIGCSE became a special interest group of ACM in 1970. It currently consists of over 2000 members from the educational, industrial, and governmental communities interested in various aspects of computer science education. SIGCSE has goals of encouraging and assisting in the development of effective academic programs and courses in computer science and promoting research in computer science education.

The following are objectives of SIGCSE:

1. To provide a continuing forum for discussion of common problems among education and other computer scientists through organized meetings and symposia.
2. To publish a bulletin at least quarterly containing information aimed specifically at those interested in computer science education.
3. To work closely with the Education Board of ACM to insure implementation of effective education programs by the Association.

SIGCUE—ACM Special Interest Group on Computer Uses in Education

SIGCUE provides a forum for the discussion of ideas, methods, and policies related to all aspects of computers in the educational process. Established in 1969, its membership (over 1,400 persons) comes from many countries and numerous, diverse institutions and businesses.

SIGCUE publishes a newsletter titled the SIGCUE *Outlook*. Recent topics have included Preservice Education in Educational Computing, International Reports on Educational Computing, and a Teacher Training Curriculum Project. SIGCUE also sponsors and organizes technical sessions at ACM annual meetings, the National Educational Computing Conference, and other national and regional meetings of interest to its members.

Among SIGCUE's goals are (1) helping to bring the technical expertise within ACM to bear upon educational compting generally, (2) cooperating with other special interest groups or educational societies to promote attention to educational computing issues, and (3) providing written and verbal forums for members and the educational community to exchange ideas concerning computer uses in education.

SIGUCCS—ACM Special Interest Group on University and College Computing Services

SIGUCCS provides a forum for those involved in providing computing services on a college or university campus. The topics addressed by SIGUCCS include managing campus computing, computing as it relates to the overall goals of the institution, and the state-of-the-art in various types of college and university computing services, and provides opportunities to discuss and share ideas and experiences with others.

Two annual conferences are regular activities of SIGUCCS. The Computing Center Management Symposium addresses the many aspects of managing computing on campus. This includes hardware, software, planning, finances, and personnel, to name few. The User Services Conference deals more directly with the delivery of particular services to the higher education community. Tutorials on relevant issues are held at both conferences.

In other projects, SIGUCCS offers a Peer Review of the university computing function. Upon request of the computer center director, members of SIGUCCS will formally analyze and comment on different areas of the campus computing function. SIGUCCS also publishes a quarterly newsletter. We consider the newsletter our most important form of communication as it reaches all members and is subscribed to by numerous university computing centers. Conference proceedings are published either as separate documents or as part of the newsletter itself.

AECT–The Association for Educational Communications and Technology

The Association for Educational Communications and Technology (AECT) is an international professional association dedicated to the improvement of instruction at all levels through the appropriate use of instructional technology. Founded in 1923, AECT has evolved as an organization as the technology used in education has evolved, from the early use of traditional audiovisual media to today's interactive and multimedia technology platforms. AECT members can be found at all levels of public and private education, from elementary schools to colleges and universities, as well as in the corporate and government sectors.

Organizationally, AECT has nine special interest divisions, eight chapters, forty-six state affiliate organizations, and fourteen national and international affiliate organizations. With over 5000 members, AECT is the largest international association for professionals involved in the integration of instructional technology to the learning process. AECT is the United States representative to the International Council for Educational Media.

Tech Trends, in its 37th year of publication, is the Association's professional periodical. Published during the school year, *Tech Trends* features authoritative, practical articles about technology and its integration into the learning environment. *Educational Technology Research and Development*, the Association's research quarterly in its 40th year of publication, is the only refereed journal focusing entirely on research and instructional development in the rapidly changing field of educational technology.

AECT also publishes reference books on a variety of topics, including practical applications of technology, research, copyright, and standards and guidelines for the field of special interest to instructional technologists.

The AECT national convention and exposition is held each year in January or February, drawing over 12,000 participants and exhibitors. Additionally, AECT sponsors an annual professional development seminar focusing on emerging technologies and a leadership development conference for leaders within AECT and its affiliates.

ASCUE—The Association of Small Computer Users in Education

The Association of Small Computer Users in Education (ASCUE) is a group of small colleges who work toward continued quality computer education and computer assistance in both administrative and academic areas. The purposes of the organization are: 1) to encourage appropriate uses of computing equipment and techniques for the improvement of its member institutions; 2) to supply its members with information on the most current computing methods; 3) to assist them in solving individual problems; 4) to cooperate with them in the utilization of the various small computers; 5) to cooperate with manufacturers, distributors, and suppliers in establishing and maintaining proper technical standards and in meeting new needs for special devices and systems.

CCSC–Consortium for Computing in Small Colleges

CCSC is a not–for–profit organization focused on promoting effective use of computing in smaller institutions of higher education which are typically non–research in orientation. It supports activities which assist faculty in such institutions to make appropriate judgments concerning computing resources and educational applications of computer technology.

Because departments in smaller colleges and universities are usually small and not highly specialized, the Consortium encourages the sharing of expertise, effective curriculum patterns, and efficient technological applications.

The Consortium is concerned with the advancement of major programs in both computer science and computer information systems, and with the use of computers in the liberal arts and sciences.

The Journal of Computing in Small Colleges is distributed to faculty in more than 200 colleges across the country. Now in its sixth volume, its five annual issues are averaging 500 pages with articles addressing the broad spectrum of curriculum and computer use in higher education.

ECMI—Educational Computing in Minority Institutions

ECMI is an organization run by a steering committee representing institutions whose student body reflects a large identifiable minority population. The objectives of ECMI are:

1. Computer literary: To create among the faculty and administrators of the minority institutions an awareness and understanding of the strengths and weaknesses, uses and issues, advantages and disadvantages, feasibility, practicality and limitations of computer applications in all aspects of society, including education.
2. Educational Computing: To narrow the gap which exists between the faculties in minority and non-minority institutions with respect to educational computing know-how and access.
3. Research Computing: To improve the computing facilities available to faculty of minority institutions for research purposes, particularly in those institutions offering graduate programs.
4. Technical assistance—consultants: To provide expert and impartial technical assistance to academic administrators of minority institutions on all phases of academic computing (instruction and research).
5. Education programs in the computer sciences: To improve the offerings of courses and degree programs in the computer sciences at minority institutions at all levels (e.g., introductory courses, minors, 2-year degree programs, 4-year degree programs, continuing education, graduate programs).
6. Computing facilities: To improve both quality and quantity of computing facilities available in minority institutions, because experience in the non-minority institutions has shown that an adequately staffed and equipped computer center for academic computing is essential to the success of previously stated objectives.
7. Direct student assistance: To increase the availability of minority staff for the computer centers and computer science education programs of minority institutions.
8. The need for a comprehensive program: To facilitate co-ordination and equitable distribution of funded activities to qualified institutions, associations, etc.

EDUCOM

EDUCOM is a nonprofit consortium of colleges, universities, and other institutions founded in 1964 to facilitate the introduction, use, and management of information technology. Through direct services and cooperative efforts, EDUCOM assists its members and provides leadership to the higher education community.

EDUCOM is funded by membership dues, service fees, and grants from foundations, corporations, and government. EDUCOM activities involve over 530 institutions and 90 corporations in the U.S. and abroad. In brief, they are: EDUCOM General Membership; the EDUCOM Consulting Group; EDUCOM Networking Activities including the Networking and Telecommunications Task Force (NTTF) and BITNIC, the BITNET Network Information Center; the EDUCOM Software Initiative; and the Corporate Associates Program.

IEEE—The IEEE Computer Society

The Computer Society is the world's largest association of computing professionals, with a total membership of approximately 110,000 computer scientists, computer engineers, and interested professionals. Society membership is open to IEEE members, associate members, and student members and to non-IEEE members who qualify for affiliate membership. An affiliate member is a person who has achieved status in his or her chosen field of specialization and whose interests focus in the computing field.

Every Computer Society member receives *Computer*, a peer-reviewed monthly magazine of general interest to computing professionals which also covers society news and events. Five specialized magazines and five journals are also available to society members as optional subscriptions and to nonmembers, libraries, and organizations.

Magazines published by the Computer Society include *IEEE Computer Graphics and Applications*, *IEEE Micro*, *IEEE Design and Test*, *IEEE Software*, and *IEEE Expert*. Research-oriented journals include *IEEE Transactions on Computers*, *IEEE Transactions on Software Engineering*, *IEEE Transactions on Pattern Analysis and Machine Intelligence*, *IEEE Transactions on Knowledge and Database Engineering*, and *IEEE Transactions on Parallel Distributed Systems*. The Computer Society Press publishes nonperiodical literature, including tutorial texts and conference records. The society's catalog contains approximately 900 titles which are available for purchase.

The society sponsors or cosponsors more than 100 conferences and meetings ranging from workshops and symposia with a few dozen participants to major conferences with many thousands of attendees. Over 30 technical committees offer the opportunity to interact with peers in technical specialty areas, receive newsletters, and conduct conferences and tutorials.

The Computer Society has over 100 local chapters throughout the world, and an additional 100-plus student chapters which provide the opportunity to interact with local colleagues and hear experts discuss technical issues. In addition, tutorials, educational activities, accreditation of computer science and engineering academic programs, the development of standards, and an international electronic mail network all play prominent roles in the society's activities.

ISTE—International Society for Technology in Education

The International Society for Technology in Education, ISTE, is the merged society of the International Council for Computers in Education and the International Association for Computing in Education. ISTE is a non-profit educational organization, with 60,000 individual members and over 40 organization affiliates.

ISTE publishes *The Computing Teacher*, *Journal of Research on Computing in Education*, *IRM Quarterly*, *CÆLL Digest*, *Microsoft Works in Education*, and books and courseware for persons interested in the instructional use of computers at the precollege level. These publications emphasize teaching about computers, teaching using computers, teacher education, and the impact of computers on curriculum.

ISTE has a substantial and growing professional outreach program. Five major components currently include:

1. Organization Affiliate Members. Members publish newsletters and/or journals, hold conferences, and directly interact with their own members.
2. Professional Staff. ISTE has a professional staff who write, edit, participate in conferences, process orders, consult by phone or mail, etc. *The Computing Teacher* is put together by a full in-house production staff.
3. Ad Hoc Committees. Such a committee created the "ICCE Policy Statement on Software Copyright" and "Code of Ethical Conduct for Computer Using Teachers."
4. Special Interest Groups. ISTE has organized special interest groups for computer coordinators, teachers of educators, computer science educators, Logo-using educators, telecommunications, and hypermedia/multimedia.
5. Independent Study Courses. ISTE offers eleven independent study courses carrying graduate credit from the Oregon State System of Higher Education.
6. Private Sector Council. The Council represents a broad range of corporations and services in an advisory capacity to ISTE's Board of Directors.

ISTE's SIGTC—The Special Interest Group for Technology Coordinators

The Special Interest Group for Technology Coordinators (SIGTC) is a professional organization that helps technology coordinators meet the challenges of a rapidly changing field. We provide an excellent forum to identify problems and solutions, and share information on issues facing technology coordinators at the precollege level.

SIGTC publishes *SIGTC Connections*, a quarterly publication, through the International Society for Technology in Education (ISTE). Articles in *SIGTC Connections* contains helpful information and answers to questions such as:

- Who's doing what to organize and communicate with teachers and administrators?
- What committees and techniques work best for other coordinators?
- How can technology coordinators enlist the support of school site administrators?
- How do others disseminate information?
- What are some successful models for providing staff development?
- How should buildings and districts establish and evaluate the use of educational technology in their programs?

SIGTC organizes a NECC workshop for technology coordinators each year and holds its annual business meeting at NECC.

SCS—The Society for Computer Simulation

SCS is the only technical society devoted primarily to the advancement of simulation and allied technology. It has a worldwide membership and a network of regional councils that covers the United States, Canada, and the United Kingdom.

Simulation is used in every scientific and technical discipline including engineering, manufacturing, biomedical, business, and aerospace. Artificial intelligence, robotics, and CAD/ACM and simulators are areas that have been specifically recognized as important to SCS members.

There are three major SCS conferences each year. They are the SCS Western Multiconference, the SCS Eastern Multiconference, and the Summer Computer Simulation Conference (SCSC).

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Henry Walker
Judith Wilson
Terry Wright
Sharon Yoder

NECC '92 Poster Sessions

Elementary Applications

Monday, June 15, 2:00 - 4:30 p.m.

1 **Space Station Alpha**
Greg Butler, *Univ. of Western Sydney, Australia*

2 **How to Plan and Implement and Elementary School-Wide Network**
Roxanne Butler, Vanessa Cunningham, Tammy Havens, *K. B. Richards Magnet High School, Kansas City*

3 **AppleWorks Applications Activities for Grades 2 to 8**
Antoinette Votava, *Educational Computer Consultant, South Bend IN*

4 **The Waikato-Kansas E-Mail Link**
Scott Waters, *Emporia State Univ.*; Hugh Barr, *Univ. of Waikato, New Zealand*; Bill Yates, *Emporia State Univ.*

Technology in Instruction

Monday, June 15, 4:00 - 5:30 p.m.

1 **Integration of Technology in a High School**
Richard Alo,*Univ. of Houston-Downtown*; Mary Gagne, *Kelly High School, Beaumont TX*

2 **AADvantage for Students with Learning Disabilities**
Janis Bing, *Region VI Ed. Service Center, Texas*

3 **Hypermedia and Multimedia** (ISTE)
Ray Braswell,*Auburn Univ.*; Annette Lamb, *Univ. of Toledo*; Bob Slotnick, *New York Inst. of Technology*; Herman Weller, *Texas Tech Univ.*; Leah McCoy, *Wake Forest Univ.*

4 **Dutch Go East**
Ton Diepeveen, *Project PRINT, The Netherlands*

5 **Favorite Introductory Computer Science and Programming Lesson Plans**
Philip East, *Univ. of Northern Iowa*

6 **Computer Generated Academic and Behavioral Interventions and Incentives**
Aileen Freasier, *Louisiana Training Inst., Monroe LA*

7 **Training Teachers to Use Technology: An Undergraduate Teacher Training Model**
Kathleen Maury, *Mankato State Univ., MN*

8 **The Horrors of the Holocaust: A Student Produced Textbook**
Sharon Shrout, *Jefferson County Public Schools, Louisville KY*

9 **Using Computer Technology to Enhance the Calculus Curriculum**
Deborah Woods, *Raymond Walters College, Univ. of Cincinnati*

Cognition and Telecommunications

Tuesday, June 16, 8:30 - 10:00 a.m.

1 **The Global Laboratory**
Boris Berenfeld, *TERC, Institute for New Technology, Moscow*

2 **Topological Panorama Camera for Pictographic Learning**
Janet Gelphman, *Gelphman Photography*; Carin Horn, *Visual Learning Lab, TX*

3 **OS/2 and Token Ring Network Management for Schools**
Janet Leistner, Milton Stirsman, *Evansville-Vanderburgh School Corp., IN*

4 **Development of Visual Languages**
H. J. McWhinnie, *Univ. of Maryland*

5 **Authoring Interactive Video Using Prolog AI Techniques**
Gary Tubb, Linda Tubb *Louisiana Tech Univ.*

6 **Developing Knowledge Bases in the Classroom: Cognitive Effects**
Herbert Wideman, *York Univ., Toronto*

7. **Literacy Skills for Special Needs Children**
Peggy McNairn, *Arlington TX ISD*

Teacher Training

Tuesday, June 16, 2:00 - 3:30 p.m.

1 **The Electro-Text Project: Reading and Studying from Hypertext**
Lynne Anderson-Inman, Mark Horney, *Univ. of Oregon*

2 **K-12 Educators and Administrators: Their Technology Training Needs**
Ken Brumbaugh, Terry Holcomb, Kathleen Holmes, Jannette Scannel, *Texas Center for Educational Technology*

3 **Cooperative Learning Activities in Programming Classes**
Theresa Cuprack, Jill Jones, *Carl Hayden High School, Phoenix*

4 **Read, Write, and Publish - Poetry Across the Curriculum**
Beverly Ellman

5 **How Can Computers be Used to Enhance Early Childhood Curriculum?**
Kathy Fite, *Southwest Texas State Univ.*

6 **A Rule-Based Electronic Mail Processor for Collaborative Electronic Learning**
Michael Jacobson, James Levin, *Univ. of Illinois*

7 **Learning Hypercard and Pushing the Right Buttons**
Maria Swayne, Jack Bauman, Tom Dooley, Karen Hare, Geri Issacson, Maria Tovare

8 **A Model to Integrate ISTE Guidelines in Preservice Teacher Education**
Nancy Todd, *Eastern Washington Univ.*

9 **Computer-Based Preservice Teacher Portfolio**
Linda Tubb, Gary Tubb *Louisiana Tech Univ.*

10 **Teaching Teachers About Computers**
Peter Wright, *Univ. of Alberta*

Resources and Centers
Tuesday, June 16, 4:00 - 5:30 p.m.

1 **The Texas Center for Educational Technology: What is it, and What Does it Do?**
Ken Brumbaugh, Kathleen Holmes, Janette Scannel, *Texas Center for Educational Technology*

2 **Macintosh in the School Library: Making Research Fun**
Susan Hamilton, *St. Thomas More High School, Lafayette LA*

3 **Mobile Computer Lab for Rural Education**
Terry Magel, Randy Oliver, *Kentucky State Univ.*

4 **USL Educational Technology Review Center**
Adaline Trahan, *Univ. of Southwestern Louisiana*

5 **A Statewide Assessment of Computer-Related Technology Use by K-12 Teachers**
Denise Schmidt, Ann Thompson, *Iowa State Univ.*

6 **Kansas Elementary School Computer Use Survey**
Bill Yates, Harvey Folye, *Emporia State Univ.*

7 **Making Yourself Dispensable: Hypercard and Daily Lab Management**
Rachel Pinson, *Mountain Brook High School, Birmingham AL*

8 **Link Knowledge with Learning: An Action Learning Model**
Bob Gillan, *Northwestern State Univ., LA*; Ross Williams, *Florien High School, LA*

NECC '92 Session Presiders

M1 Sessions - June 15, 8:30 a.m.

02	Dale Magoun, Northeast Louisiana Univ.
04	Sue Nipp-Horn, Sand Springs Public Schools, Tulsa
05	Bill Martinez, Dallas TX ISD
06	Joyce Taylor-Lane, Bellaire High School, TX
07	Terry Theriault, Austin TX ISD
08	Cindy Meyer Hanchey, Oklahoma Baptist Univ.
09	Richard Bradley, The Hockaday School, Dallas
10	Billie Miles, San Antonio TX ISD
11	Patricia Rayburn, Texas Assn. of School Boards
12	Karen Turpin, Round Rock TX ISD
13	Leroy Roquemore, Southern Univ.

M3 Sessions - June 15, 2:00 p.m.

01	Suzy Gallagher, The Univ. of Texas at Austin
02	Richard Austing, Univ. of Maryland
03	Jeri Hodges, Dallas TX ISD
05	Dale Hanchey, Oklahoma Baptist Univ.
06	Jamie Alexander, Radio Shack Education Div.
07	Kathleen Maury, Mankato State Univ.
08	Mary Lou Cenatiempo, St. Vincent De Paul School, Houston
09	Geraldine Trotter Carroll, Detroit Public Schools
10	Charles Price, Garland TX Independent School Assoc.
11	Doris Harvey, Galena Park TX ISD
12	Nickie L. Weaver, Irion County Elem. Mertzon TX
13	Steven Harvey, Arlington TX ISD

M4 Sessions - June 15, 4:00 p.m.

01	Helen Padgett, Imes Magnet School, Glendale AZ
03	Alan Maples, Cedar Valley College, Lancaster TX
05	Theresa Overall, Lamplighter School, Dallas
06	Dianne O'Dell, Region 18 ESD, Midland TX
07	Crystal Armstrong, Northeast Louisiana Univ.
08	C. G. Gray, Abilene Christian Univ.
09	Ted Sjoerdsma, Washington and Lee Univ.
10	Gloria A. Belisch, Forest Oak Middle, Fort Worth
11	Paul E. Resta, The Univ. of Texas at Austin
12	Sheila Cory, Chapel Hill-Carrboro City Schools
13	Judi Repman, Texas Tech Univ.

T1 Sessions - June 16, 8:30 a.m.

02	Lillian Cassel, Villanova Univ.
03	Peter W. Wright, Univ. of Alberta
05	S. W. Hollingsworth, Northwest TX ISD
06	Bill Stack, Pine Tree TX ISD
07	Gerald Crisci, Scarsdale Public Schools, Nanuet NY
08	Karla K. Burkholder, Plano TX ISD
09	Helen McClain, Region VII Ed. Service Dist. TX
10	Herman G. Weller, Texas Tech Univ.
11	Raydell O'Neil, Whitney Middle School, TX
12	Teri Perl, Teri Perl Associates
13	Barry Pitsch, Heartland AEA II, Iowa

T3 Sessions - June 16, 2:00 p.m.

03	Doris K. Lidtke, Towson State Univ.
05	Linda Booth, DLM, TX
06	Mary Bird, Univ. of Central Florida
07	Anne Meyn, West Univ., Houston
09	Kaye Coats, Clyde Boyd Jr. High, Sand Springs OK
10	Carol Utay, Shelton School, Dallas
11	Ed Palmer, Dripping Springs Middle School, TX
12	Diane McGrath, Kansas State Univ.
13	Rose Mary Gallagher, Mission CISD TX

T4 Sessions - June 16, 4:00 p.m.

02	Ron Classen, Northeast Louisiana Univ.
03	Neal Strudler, Univ. of Nevada, Las Vegas
06	Jerry Stimmel, New York City Board of Education
07	Bob Price, Texas Tech Univ.
08	Richard Pollak, Emerging Technology Consultants, St. Paul MN
09	Mary Meinardus, Greenhill School, Dallas
10	Deb Palmer, Dripping Springs Middle School, TX
11	Jerald D. Robinson, Texas Tech Univ.
12	Sally J. Martin, Westlake High School, Austin
13	Penny Weisler Bond, Conroe TX ISD

W1 Sessions - June 17, 8:30 a.m.

01	Cornelius Moon, Calcasieu Parish Schools, Lake Charles LA
03	R. Waldo Roth, Taylor Univ.
05	Mary Jane Robison, Jack Hayes Elem. School, Monroe LA
06	Ivy Montoya, Miami Central High School, FL
07	Ruth M. Caswell, Texas Women's Univ.
08	Pat Jackson, South Grand Prairie High School, TX
10	Teresa Franklin, Kinkaid School, Houston
11	Cheri Halderman, Region 10 Ed. Service Center, TX
12	Nina Grantham, Comal TX ISD
13	Cathy Carney, Alaska Dept. of Education

W2 Sessions - June 17, 10:30 a.m.

01	Robert Gillan, Northwestern State Univ., LA
03	Clifton S. Harris, Univ. of Texas at Dallas
05	Virginia Lumpkin, Calhoun Junior High, Denton TX
06	Hope Erickson, Eanes TX ISD
07	Mary Lou Pointon, Fairhill School, Dallas
08	Kathy Kothmann, RMS Consulting, College Station TX
09	Bobbie Moon, Calcasieu Parish Schools, Lake Charles LA
11	Janie Hale, Arlington TX ISD
12	Donna J. Baumbach, Univ. of Central Florida
13	Sally Brewer, Univ. of Central Florida

W3 Sessions - June 17, 2:00 p.m.

01 Anita Best, ISTE
02 Herbert S. Hamilton, New Mexico State Univ.
03 Robert A. Thomson, Univ. of Dayton
04 Erline Schecter, Bassett Middle School, El Paso
05 Nancy Hearne, Swartz Elem., Swartz LA
06 Allen H. Henderson, Texas Wesleyan Univ.
07 Lane Scott, Texas Education Agency
08 Peggy Cloud, Caddo Magnet School, Shreveport LA
09 Tony Jongejan, Western Washington Univ.
10. Barbara Flynn, Arlington TX ISD
11 Linda Lines, Austin College
13 Sam R. Burnes, Matagorda TX ISD

Spotlight Session–Going Dutch, by Satellite

Windows on The Netherlands: Collaboration and Commitment with Information Technology in Education

Ton Diepeveen and Marijke van der Bruge
Project for the Implementation of New Technologies

Betty Collis and Gerrit Carleer
University of Twente

Pieter de Vries
University of Leiden

Sonja van Vooren
Educational Computing Consortium

Tineke Zeelenberg, Jan Lepeitak and Bram van Weering
National Institute for Curriculum Development

Introduction

The purpose of this international videoconference is to highlight some of the large variety of activities involving information technology in Dutch schools. Examples will be given of projects and activities in elementary and secondary schools; of Dutch innovations with respect to educational software, multi-media, and telecommunications use in education; and of projects involving The Netherlands and other countries throughout Europe. A main aspect in these activities is collaboration, working together toward restructuring in education.

Interconnectedness, in Society and Education

The Netherlands is a small, densely populated country in the center of the European Community. Rapid technological developments in society and rapidly escalating interconnectiveness within Europe and with the rest of the world are reflected in the sorts of educational developments that are occurring in our land. We are committed to the idea that our students must develop the skills and understandings necessary to function in this emerging interconnected information society. As one aspect of this, we see an increasing demand for more flexible education and new forms of collaboration to bring about change and even restructuring in the educational system. One way in which this is occurring is a change away from a centrally led and managed education system where the school and citizen are more and more responsible for themselves and their own initiatives,

In education, this restructuring is being translated as "the autonomous school." In this vision, schools will become self-standing units that can determine their own policy, with the central Ministry only establishing some overall learning objectives. Through a form of "partnerships" with other schools and industry, schools will be able to get money from the Ministry for special projects and activities, but these projects and activities are planned and managed by the partnerships. In the future, the schools therefore will more and more make their own policy and choose their own services and resources, on the basis of a total school commitment. Schools who share a certain vision will work together in different kinds of collaborative networks. Schools may also transform their sense of their target groups and even their physical boundaries, as demand for life-long learning and (re)training increases in society. The schools may become centers for adult education as well as for the traditional age groups of students. And even in a small land such as The Netherlands, the need for and use of telecommunications for "telecooperation" and "telelearning" will steadily grow. And, as the borders–political and geographical–are changing so rapidly in Europe, the need to find flexible ways of being in contact with the world outside the schoolroom or the office or the home will continue to increase. Information technology and telecommunications are of major importance to give us and our children the skills to find our way in the information society and to be part of the interconnected world.

This transition in our schools is happening on the basis of considerable experience and experimentation with different forms of collaboration in education. In particular, we can see many different examples of collaboration and commitment with respect to the introduction and support of information technology in schools. In this teleconference, we will "open the windows" on The Netherlands to get a glimpse of some of the many examples of collaboration that are occurring in The Netherlands with respect to "working together to total commitment" with regard to new technologies in education.

Collaboration and Information Technology in Education in The Netherlands

The Dutch word for collaboration is "samenwerking", working together, and samenwerking is a key theme in our activities with respect to stimulating the use of information technology in education. In this teleconference, we will try to "open our windows" to give NECC participants a look at a number of different projects that show how "working together" works in The Netherlands. We will interactively visit projects or people connected to projects that show many different aspects of working together:

1. Working together within the school–The "Proefschool" project –where partnerships between schools, the universities, and the Ministry have stimulated total-school commitment to exploring the uses of computer-related technology in education.

2. Working together for software development and dissemination - the "POCO" project, where the educational community, educational publishers, and software development companies are working together in a nationwide long-term project to bring quality software into Dutch schools.

3. Working together for support of computers in elementary education–the PRINT/COMENIUS project–where national support guides the integrated infusion of hardware and software into elementary schools throughout the country and where teacher training (and also "training" of the school principals) takes place in partnership with the teacher training institutions, the institutions for support in the schools, and even a national institution for educational television.

4. Working together to create innovative multi-media learning materials–the "COMPUTERJOURNAAL" -- where the National Curriculum Institute, the National Center for Educational Television, and the Dutch PTT Telecom (telephone and telecommunications service) collaborate in the development and dissemination of multi-media, curriculum-related learning materials throughout The Netherlands.

5. Working together on telecommunications initiatives, both national and international, where one of the many telecommunications activities taking place in Dutch schools and for Dutch teachers will be highlighted as an example of working together in a European perspective.

6. Working together to stimulate and coordinate innovation and implementation of information technology in education–the PRINT project–as national leadership for innovation and collaboration in education involving information technology. One of the many partnerships between the universities, teacher training institutes and the PRINT project has resulted in the innovation of the national physics curriculum by integrating information technology.

Conclusion

Our conclusion, with respect to this Special Session and teleconference, will only be a beginning, a beginning of making new connections, friendships, and partnerships through our participation in NECC. In a later (project) session of NECC '92, "Information Technology in The Netherlands: From Project to Total School Commitment," we will describe in more detail the projects we have taken a "bird's-eye-view" of during our teleconference. In this Spotlight Session we have opened the windows on our Dutch activities, showing how we work together for change and improvement in education with the help of new technologies. We invite you to visit us again–but next time, not only a "televisit!"

ADAPT–Spotlight (M1-02)

Integrating Computers Into a Functional Curriculum

Susan Long
Franklin County Board of Mental Retardation and Developmental Disabilities
Worthington, Ohio

Abstract

This session will focus on the integration of technology into the daily routine of cognitively and physically handicapped learners. Participants will observe how the practical application of technology (including various input devices, augmentative communication alternatives, and adaptive firmware card setups) can take an individual from spectator to participant in the classroom, in the community, at home, at work and at play. Numerous examples of integration activities will be provided through discussion, demonstration, and videotapes. Resource lists will be provided.

Special Presentation–Panel (M1-03)

Computer Science in High Schools: Where Are We Going?

Chris Stephenson
University of Toronto
Toronto, Ontario

Diane McGrath
Kansas State University
Manhattan, Kansas

Abstract

The purpose of this panel is to provide a focus for discussion of a broad range of issues relating to computer science education at the high school level.

Each of the invited panelist is a recognised authority on computer science instruction. Selection of these individuals has also been determined, to some extent, by their programming language of preference, to ensure that a number of viewpoints are represented.

The panel will be organized in two parts. During Part One, the panelists will be asked to address a number of current issues in computer science education. Broadly outlined, these are:

1) Is programming important and do we need to justify it?
2) Is programming an end in itself or should we be using programming to teach something else?
3) What is the best language for teaching what needs to be taught?
4) Are we adequately preparing our students for the college computer science curriculum?
5) What's wrong with the way we are teaching computer science and can we teach it better?
6) What will be the essential components of secondary computer science education in ten years and how do we need to change?

Each of the panelists will be allotted ten minutes to discuss these issues. All of them have been encouraged to interpret these question guidelines loosely so that they may give particular emphasis to concerns that they believe are important.

During Part Two, the discussion will be opened to the audience. It is hoped that this will encourage a lively discussion/debate on the points raised by the panelists. It will also provide participants with an opportunity to initiate discussion on issues not addressed during Part One.

Panelists:

Suzy Gallagher
University of Texas at Austin
Austin, Texas

Brian Harvey
University of California-Berkeley
Berkeley, California

Ric Holt
University of Toronto
Toronto, Ontario

Arthur Luehrmann
Computer Literacy Press
Berkeley, California

Sharon Yoder
University of Oregon
Eugene, Oregon

Special Presentation–ISTE/SIGTC (M1-04)
What Every Technology Coordinator Needs to Know

Whose Job is it Anyway?

Abstract

The role of technology in education has changed drastically over the last few years. Technology has affected every aspect of education from the temperature of buildings to whether or not payroll is on time to multi-media student developed presentations to curriculum management and evaluation. Who is responsible for the coordination of all this technology? Who should determine what purchases are made and why? Who should decide what software is used for what functions? Is there a master plan out there somewhere? Does anyone know the answers?

A panel discussion from six different perspectives on Technology Coordination. Interaction between participants and the panel will be encouraged. Please come prepared to ask questions and share your experiences.

Panelists:

Mike Burns, Program Coordinator
Ralston Public Schools
Ralston, Nebraska

Connie Baxter, Principal
Westmont Elementary School
Papillion, Nebraska

Jane Caughlin, Media Specialist
Valley Public Schools
Valley, Nebraska

Jane Ludwig, Curriculum Manager
Educational Service Unit #3
Omaha, Nebraska

Dennis McIntyre, District Coordinator
Westside Community Schools
Omaha, Nebraska

Bill Menousek, Technology Specialist
Educational Service Unit #3
Omaha, Nebraska

Paper (M1-05)
Interactive Multimedia: A Performance-Based Model of Inservice Education

Marty Karlin
Jackson ESD
Ashland, Oregon

Abstract

A variety of ongoing group and individualized staff development opportunities, combined with performance expectations are ingredients in a successful inservice project.

Introduction

The fires of interactive multimedia technologies are burning brightly. At the 1991 National Educational Computing Conference in Arizona, nearly one hundred regular, and thirteen featured sessions were devoted to inter/multi/hyper media. During the 1992 NCCE Conference in Seattle, nearly one third of the sessions referred to inter/multi/hyper media. There is little question that immediate access to text, visual images and audio through electronic means offers knowledge workers powerful educational tools.

Between 1989 and 1991 thirty teachers from seventeen schools in Northern California volunteered to participate in a staff development project to integrate interactive laserdisc technology in their classrooms. Equipment, staff development, teaching methodologies, the effects on teachers and students, and the role of the administration are some of the issues considered during the course of this inservice. The purpose of this paper is to review the rationale, process, issues and implications associated with the equipment acquisition and staff development program for the planning and implementation of interactive multimedia tools.

Rationale

Educational Goals

Current research and contemporary educators are calling for teaching methodologies that are multi-modal, thematic, and involve curriculum integration; that provide opportunities for collaboration, higher order thinking, problem solving, and communication. Children are to learn to obtain and value knowledge, reach conclusions, and develop sound judgment. Learning to use computer-based information systems can help accomplish these goals by making available to educators and educatees visual and auditory information in an intuitive environment, whose climate is the application of knowledge.

What characterizes the Information Age is our relationship to information. With technology, we can greatly affect the quantity and quality of teacher and student performance by offering access to an enhanced knowledge base, search capacity, organizational ability, and presentation possibilities to go with our unique personal skills. To help teachers see the potential and begin to use technology requires a commitment to staff development, adequate equipment, and time. Ultimately however, the motivation for change must come from within.

Change

Inservice is a vehicle for promoting change. Staff development must take into account the difficulty in enacting change. There are four kinds of change: in knowledge, attitudes, behavior, and performance quality. Moving from one to the other becomes increasingly difficult, (Wu, 1988.) Content knowledge, equipment operation, software and teaching materials familiarity, classroom management, and teaching methodologies are all affected. The change process must address each of these areas.

Motivation is critical in enacting change. In a study of 1150 teachers, it was noted that teacher motivation is for the most part intrinsic. Thirteen conditions were identified as a guide in helping to improve motivation (Fox, 1986:)

- Worthwhile— inservice creates a strong value for learning and builds a sense of worth
- Stimulating—inservice encourages new and improved instruction delivery, adding freshness and vitality
- Involvemen—teacher involvement in decision making creates ownership
- Independence—collaboration fostered by inservice stimulates confidence, control, and as a result, greater independence
- Affiliation—peer relationships increase collegiality and professionalism
- Rewards— extrinsic rewards are an important motivator. Intrinsic rewards are an outcome of a research-based program of inservice
- Success—continued financial and emotional support help insure inservice success
- Recognition—and appreciation grows between faculty during inservice
- Feedback— a climate of non-threatening feedback comes from peers

- Growth—personal and professional growth opportunities are enhanced through teacher involvement in the decision making process
- Confidence—having the training and support to do a job well has much to do with self esteem
- Resources—when adequate resources are provided, the staff sees strong commitment
- Safety—emotional safety is achieved through mutual support and respect, a bi-product of successful inservice programs

Interestingly, these conditions are to be found in vibrant classrooms.

Educational System

As a system, education has been slow to incorporate technology as an everyday part of classroom life. It is left to motivated teachers to acquire the skills and beg for the materials needed to integrate technology into the curriculum. Since the system hasn't provided the level of support needed to meaningfully implement new technologies and new methodologies, many teachers have been able to ignore, by design or lack of opportunity, contemporary teaching tools. Those who have used computers often confine themselves to tutorials and drill and practice programs. One inservice goal is to bring along the reluctant and inexperienced.

Tool Software

To take advantage of the power of the computer, teachers need to explore computer-based tools. The purpose of a computer-based tool is to help a person accomplish a task. Control of the environment is in the hands of the user. The tool can make the user more efficient and effective. With control comes versatility, and the individualized ability to meet a wide range of teacher and student needs. Though it takes greater effort to master tool software, it yields greater returns in the long run. Working with computer-based tools lends itself to process-oriented learning including inquiry, writing, problem solving, decision making, collaboration and other applications of higher-order thinking skills which support concept learning and provide access to information (Hunter, 1987). Empowerment through computer-based tools can open higher order worlds. Tools, under personal control, give us the means to construct our own understanding, along our own paths, connecting to what we know. Personalizing learning affects motivation. Interactive multimedia technology appeals to multiple modalities and intelligences.

The Project

Background

Trinity County is a rural area with 17 schools and 11 school districts encompassing 3200 square miles. Six schools have two teachers. One has three. The tourist and timber economy, with high seasonal unemployment, results in a low socioeconomic lifestyle. Geographic isolation and few teachers per school limit opportunities for peer support.

Through a state of California grant, a Macintosh and laserdisc player was purchased for each school. A library of discs was made available through weekly distribution managed by the county Instructional Media Center.

The project involved two training phases. First year participants were expected to deliver at least one multimedia augmented lesson. This meant learning:

- To use a Macintosh and laserdisc player
- A computer program which allows for finding, arranging, storing, and presenting multimedia information
- Techniques of electronic searching for information
- New methods of instruction and classroom management

Second year participants were expected to present at least one multimedia lesson, facilitate student use of multimedia, and act as mentors for Phase 1 teachers. Teachers first had to become comfortable in using the equipment themselves before managing student access and sharing projects with other schools. This is important. It is easy to forget about good pedagogical practices while struggling with details of hardware and software mastery.

Teachers attended up to five days of workshops including a Macintosh and laser technology introduction, subject specific laserdisc demonstrations and practice sessions, and beginning HyperCard programming. Each teacher received a half day of one-on-one assistance to develop a lesson to coordinate disc use with existing classroom curricular objectives. Lesson development was followed by a class visit to provide help, to observe the teacher or student presentation, and following the presentation, to discuss the implications of interactive videodisc use on teaching and learning. Additional support was available from teachers on-site, from teachers in neighboring schools that had undergone training the first year, or through additional one-on-one assistance from the coordinator.

Expected student and teacher outcomes were to:

- Make available frequent hands-on technology time in the use of information access and presentation tools
- Foster collaboration and communication among and between students and teachers
- Increase subject knowledge
- Improve confidence, motivation, and attitudes
- Improve quality and variety of teaching and learning experiences
- Increase use of technology supported instruction and learning
- Improve accessibility to educational materials
- Employ teaching strategies outlined in the California Frameworks.

Inservice is more difficult in rural areas where peer support, (not just in technology, but in curriculum as well), is often many miles away. Telecommunications offers possible solutions to having limited professional contact, but requires additional commitment, training, and equipment.

The support system necessary to accomplish these goals includes administrative and technical support, significant access to hardware and software, and comprehensive group and one-on-one training. Paid substitute time relieves financial burdens on schools.

Funding

Approximately $90,000 was spent through this project.

Hardware and software	$56,000
Training	$30,000
Substitutes	$ 4,000

Results

A seven page evaluation was completed by 24 participants. The issues raised and trends recorded are noted here in order to further awareness of the factors and implications surrounding the use of interactive laserdisc technology.

Demographics

Thirty county teachers out of 135 received training. Participants reported varying effects on other teachers in their school. There were, at a minimum, thirty-five non-participating teachers in some way affected by the project. 853 students were directly exposed to laser technology, and 719 more were indirectly affected. Before the training, 2/3 of the teachers did not use any computer technology in their class. Following the training, 80% felt capable of using interactive multimedia, and 96% plan on using laserdiscs in class either regularly (58%) or occasionally (38%). Other intended future technology use includes telecommunications, hypermedia projects, lab interfaces, simulations, graphics, and computer-based tools. No one mentioned drill and practice. 88% of the teachers used laserdiscs for reference and presentations. 75% personally used or had students using computers with some frequency, even though 1/3 had equipment problems - usually a lack of knowledge rather than equipment failure. 66% had 10 or more students using laserdiscs. There were at least 80 student classroom presentations. Three teachers used laser technology daily. 16 out of 17 school sites are purchasing additional materials.

Software

The Instructional Media Center recorded a total of 81 separate teacher checkouts for approximately 20 titles, for up to two months. Some school districts purchased their own materials and used those. The coordinator loaned out his personal library of discs as well. During the year, discs were rarely available through the media center without advance reservation.

Staff Development

Usefulness of staff development sessions was rated on a scale of 1-5 (3=moderately useful, 5=highly useful.) Participants were moderately satisfied with group sessions (3.3), and found one-on-one sessions (4.5) highly useful. Classroom visits, laserdisc and Macintosh introduction, HyperCard and Visual Almanac were rated a 4. 84% felt all staff development was relevant and organized in a manner that facilitated learning. 30% expressed a desire for more one-on-one and on-site help. Comments reflected a desire for more time, staff development, and hardware. 75% want to have staff development continue for themselves, and 65% want to extend staff development to new participants. Only 17% felt administrators should receive training.

Factors Affecting Laserdisc Use

The biggest factors affecting laserdisc use noted by teachers were time, staff development, and hardware access. Time and equipment were mentioned repeatedly as major difficulties encountered by teachers. On a scale of 7 (1=greatly impeded, 4=no effect, 7=greatly supported), planning time was the greatest impediment (2.6). Some teachers had geography and equipment problems, but on average these were rated to have no effect (3.8-3.9.) All other factors supported laserdisc use - prior school technology use (4.7), teacher comfort (4.9), hardware and software availability (5.2), administrative support and peer support (5.3), teacher interest (5.7), coordinator support, media center support, staff development sessions, student motivation, and teacher motivation (5.8-5.9.)

Impact of Laserdiscs on Students

Two teachers were not satisfied with the impact of laserdiscs on students. One mentioned that students neither enjoyed nor were impressed by laserdiscs. Both teachers were from the same school which had a high degree of top down decision making. Most comments however, noted high excitement and motivation, the perception students had of controlling their learning environment, the positive effect of visuals on learning and on increasing student participation in discussions, an increase in quality of student work, and the worlds that were opened to the students. On a scale of 5 (3=moderate, 5=significant), motivation, interest in technology, and gender equity were rated at 4.3. Quality of learning experience received a 4. Average responses of 3.6-3.8 were recorded in knowledge and skills in emphasized subject area, initiative, understanding, quality of work, and information access by students. Frequency of use was rated at 3.1.

Impact of Laserdiscs on Teachers

Most teacher use was as an aid in classroom presentations. Some teachers used the media as a reference tool for their own learning. Responses on a scale of 5 were: making teaching more interesting (4.3), accessibility to visual materials and improving the quality and variety of teaching (4.2), integrating technology (4.1), facilitating thematic learning, encouraging student observation, the ability to offer resources beyond the textbook (4), encouraging critical thinking, promoting interactive experiences among students, and promoting teacher confidence in technology use (3.9.) Developing student understanding not otherwise possible to teach and facilitating cooperative projects averaged 3.6. Promoting communication between teachers in the same school and among teachers of different schools was rated at 2.9 (moderately significant). Significant personal changes for teachers were recorded in knowledge, attitudes, behavior, and motivation. Those who noted little change in these areas remarked that they were already informed, motivated and using technology in their classroom.

Conclusions

For the most part, teachers feel laserdiscs are a significant medium. Though some participants did experience technical problems, most were able to solve them with help from either teachers on-site, in nearby schools, or through phone calls to the coordinator. Very few who were able to put independent effort into learning the technology did not succeed in delivering laserdisc assisted lessons. The technology is getting easier and more intuitive. It is not frustrating. Problems with technical manipulation of programs are decreasing. Teachers are developing "buy-in" on an intrinsic level - they believe it impacts learning—and therefore are more motivated.

Teachers mentioned certain areas of concern. Planning time was by far the biggest problem, though only 50% of the teachers wanted to see planned opportunities for curriculum development. 75% of the teachers had access to the hardware for more than 50% of the time, but 38% mentioned equipment access, and to a lesser degree software access, as a problem. All participants felt that it was important to have the equipment cabled together and located in their classroom. If equipment is separated and used for other purposes, or if it needs to be shared, the likelihood of regular use diminishes.

An additional area to consider is the need for an ongoing, planned continuation of staff development activities. Teachers have just begun to scratch the surface of laserdisc use. Most classroom presentations observed were lecture type lessons using visuals to illustrate the lecture. Students were often told what to observe rather than asked to make observations and comparisons, or construct unique perspectives. The ability to freeze, slow down, or speed up time as a tool for analysis was likewise underused. Another untapped use was in assessment.

Teachers should have opportunities to cooperatively develop curriculum, observe lessons, and discuss their observations under the guidance of a trained curriculum leader. Though teachers should plan units and lessons carefully, they should be prepared to take advantage of the non-linear nature of interactive multimedia. Little deviation from planned presentations was observed.

The nature of training sessions is also worth considering. Though group introduction to laserdiscs is important to the process, one-on-one and small group training is essential. With interactive multimedia, particularly in the early learning stages, teachers run into many small obstacles that require immediate response or they get stuck. Large groups take away the opportunity for immediacy. Tailoring the medium to each teacher's needs requires a low ratio of participants to trainers. This was evidenced in informal evaluations following the classroom visit and in the summative evaluation.

Quantity or quality of training didn't appear to be a problem with teachers. Nevertheless, teachers mentioned a desire for more training, and had many suggestions relating to the structure of the training sessions. There is strong recognition that training must be ongoing, in a variety of formats, and that there be opportunities for teachers to share ideas and problems.

The one area I hoped to see greater progress in was in inter and intra-school communication. In small rural schools, teachers do not share grade level or subject assignments, making it more difficult to foster collegiality. Teachers did help each other with technical problems encountered with software and hardware. It was anticipated that through telecommunications, teachers and students of different schools would share projects and experiences. This did not occur. Opportunity for sharing did take place at the end of the year at a Laser Technology Faire. Twenty students and fifteen teachers presented projects. It exposed teachers, students, board members, administrators, and parents to a variety of teaching ideas and materials.

Performance-Based

A performance-based model of inservice education was designed, founded on current research in implementing innovations, use of technology and inservice methodology. Participants were asked to present a lesson during the class visit and for the Technology Faire. A number of teachers mentioned that the visit was the motivation for following through with a lesson. However, once they did, the use of the technology didn't seem that difficult.

For some, technology remains difficult—electronics are frightening, time doesn't permit, practice doesn't occur. Other teachers have begun to habituate to the technology and turn on the computer and laserdisc player first thing in the morning so that access to visuals is immediate and responsive. Audio-visual projects for students is becoming part of the curriculum.

It takes considerable time and energy to master new environments. Coordinating material purchases, training, curriculum development, and meaningful teacher/student projects are also necessary for long term behavioral change. Not all teachers will continue using these innovative technologies without an ongoing professional development program and the interest, recognition, and support by administrators and school boards.

Summary

The process of enacting knowledge, attitudinal, and behavioral changes requires motive, opportunity, and weapon.

- A meaningful goal resulting in a product to focus the purpose and measure the result
- A variety of ongoing inservice and practice opportunities
- Access to hardware and software
- A network of peers to provide support, and share ideas and expertise

The technology has become relatively easy to learn. The variety and quality of interactive laserdiscs are impressive. The fire burns. A higher order awaits.

References

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Paper (M1-05)

Implementing and Evaluating Interactive Video Technology: Instructional Improvement/Enhancement Project

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Abstract

This paper discusses the results of a project to implement interactive video (IV) into a university. California lottery funds were used to gather and disseminate information, train faculty and staff, encourage experimentation, and determine the advantages and disadvantages of applying the technology effectively in the university business classroom.

Four IV courseware packages were administered to over 525 learners individually and in groups. To determine attitudes of users toward IV, a User Evaluation of Interactive Video *form was completed by a sample of 151 of those exposed to the systems. Comparisons were made by type of exposure (group or individual) and between group and individual respondents. Compared with a hypothesized response of 3.0 (undecided/neutral) on a five-point scale, the average response scores were 3.60 for groups and 3.66 for individuals, indicating a high level of agreement and a perception of high quality and suitability of the hardware and courseware. Groups agreed with 23 of 24 question at a significant level, and individual users rated 20 of 24 questions agreed at a significant level.*

It was found that there are a variety of successful strategies for implementing IV into the university curriculum. Learners enjoy using IV with its flexibility and real-life simulations and active rather than passive participation. They also prefer IV to reading a book and felt they learned more than with a similar amount of time on conventional instruction. Cost and ability to develop materials easily remain factors to more widespread adoption, and IV was found to be a supplement, not a replacement for conventional instruction.

Introduction

The cost of education is growing along with the acceleration of knowledge and the increased complexity of the workplace. The rapid population growth in the world, which will see over six billion people in the world by the year 2000, will further increase the need for education, training and effective communication.

The difficulty of hiring and financing teachers and providing uniform instruction has motivated educators to search for more efficient means of instructional delivery. Research has shown that interactive video (IV) has been shown to be more effective and allows simulations, thus avoiding the need for time-consuming, expensive, or dangerous "real-life" situations. Universities, however, are just beginning to become involved in applying IV, and much more needs to be done to capitalize on the possibilities of this new technology in higher education.

While there is considerable general information regarding the development and general applications of interactive video in instructional technology, there is relatively little experience, information, or applications in various university settings, especially business programs.

At a growing number of companies, routine classroom programs are being displaced by interactive computer courseware which provides personalized, self-paced instruction (Henry, 1989). While IV has been introduced quite widely into large corporate settings as well as being used in other large-scale applications, the extent of its dispersion into the broad ranks of the educational community and in university education is less clear. This prompted the initiation of a project to examine IV use in a university setting.

Related Research

IV (Interactive Video), basically CBT (Computer-Based Training) with the addition of a controlled videodisc, adds realistic live simulations, stereophonic (or multi-lingual) tracks of sound, and full color to give IV additional dimensions which contribute to realism and instructional effectiveness. The key element to IV and Interactive Multimedia (IMM) is *interactivity* (Stefanac and Weiman, 1990), and interactivity may be defined as "The degree to which participants [only one need be human] in a communication process have control over and can exchange roles in, their mutual discourse" (Williams, Rice, & Rogers, 1988). Research indicates a generally favorable view of interactive video as an instructional tool. Studies are mixed on the effectiveness of IV from an economic standpoint for this technology, still in its early stages of development.

Interactive video (IV) has shown the promise of reducing student learning time, increasing retention rates, boosting sales and reducing costs (Grossman, 1988; Maher, 1988). IV equipment has been successfully used to: teach CPR (Cardio-Pulmonary Resuscitation (Training and Development Journal, 1983b), train computer technicians (*Training and Development Journal*, 1983a), train hourly workers in the fast-food industry (Barr, 1990), teach mathematics to plant workers (IBM, 1990b), teach MBA students problem solving (Training and Development Journal, 1986c), teach physical science to high school students (IBM, 1990a), and to learn the effects on cognitive achievement and attitudes toward IV of nursing students (Soled, 1989).

A survey was conducted to determine the nature and extent of usage and perceptions of interactive video by selected members of the American Society for Training and Development (ASTD). Respondents listed many advantages such as the realism, immediate feedback, self-paced training, and individualized instruction. On the other hand, cost was considered to be the most significant barrier to adoption, and non-compatibility of systems was felt to decrease efficiency. The advantages were thought to outweigh the list of drawbacks and 75 percent stated they would likely increase their use of interactive computer-based systems in the future (Jones & Weber, 1989).

Purpose

This paper presents the results of an instructional improvement/enhancement project, funded by a California Lottery Grant, designed to implement and evaluate interactive video in a university setting. The primary purposes of this project were to:

1. Develop specific Interactive Video (IV) projects:
   a .Integrate IV technology and courseware into existing courses. Set up and operate IV workstations in the college in which students, faculty, and others from throughout the campus can work with and learn about interactive video applications.
   b. Evaluate IV systems and courseware as to their effectiveness and applicability in the university curriculum.
   c. Work on the creation of interactive educational applications.
2. Develop and teach training sessions for interested faculty and staff to allow them to become better informed about possible IV uses in educational programs.
3. Perform a CSU (California State University) system-wide study of IV usage, identifying individuals and departments on each of the 19 campuses where IV is used or planned. The results of the study would be the basis for a network of campus IV personnel.
4. Disseminate the results of the project.

Research Plan

California Lottery Grant funds allowed faculty assigned time, a student assistant to aid with a variety of tasks, the purchase of some additional videodisc courseware, and the cost of a survey of California State University interactive video users.

The instructional software material on a specific topic used at any time in an IV hardware system is called courseware. Courseware is normally composed of: (1) a laser videodisc, (2) a computer program on floppy discs which controls and records the responses and interaction, and (3) student and/or instructor's manuals or workbooks. The courseware modules used in this study were *Oral Communications* and *Written Communications*, *The Business Disc* (how to start and operate a small business), and *Decision Making*. Students in a five or six different business classes and in an international management seminar completed the modules.

The hardware consisted of PCs with hard drives connected to IBM InfoWindow Touch Screen Systems and Pioneer industrial LaserDisc players, along with the required interface cards and cabling. A printer was also used to print out student progress reports. A Sony video projection system was used in presenting the material to groups.

Courseware modules were presented in two modes (individually and to entire classes) and a sample of users was asked to complete a *User Evaluation of Interactive Video* form utilizing a 5-point Likert scale (5 = SA—Strongly Agree to 1 = SD—Strongly Disagree) which measured their attitudes toward the hardware and courseware. The null hypothesis was that users would be neutral in their responses (3.0 = undecided/neutral) to questions about the system and materials. The Statview SE+ statistical package on the Macintosh was used to determine the significance of mean scores for all users, groups, individuals, and between group and individual users. Significant differences in t-scores between groups and individuals were interpreted to mean that those using IV in groups differed in their attitudes toward the systems from those using it individually. The significance of the mean scores for the individual and group learners separately was tested using one-sample t-tests, with significant scores indicating the strength and direction of respondent attitudes—whether they agreed with (were favorable) toward the hardware and courseware.

For the survey of the California State University, a questionnaire was prepared and mailed to all campuses. The results were tabulated in a database, disseminated to the respondents, and the resulting database useful for future activity planning.

On-campus workshops were set up in cooperation with faculty from other schools on campus and the Instructional Technology Center. Publicity regarding the seminars was made throughout the campus, all equipment was set up in the seminar room, and demonstrations prepared.

Results

The following are the ways in which the project's purposes were fulfilled.

Integration of IV into Existing University Business Courses.

Systems were utilized in two ways: (a) brought into classrooms on a cart and projected via large-screen video, and (b) placed in a laboratory where students signed up for laboratory time to use the equipment individually. Instructions and procedures were developed, laboratory assistants trained, evaluation forms developed, and consultation/instruction with involved faculty was undertaken.

The IV systems and courseware were evaluated as to their effectiveness and applicability in the university curriculum. A sample of those exposed to the interactive video system/courseware were given the *User Evaluation of Interactive Video* form and asked to complete and return it to the sponsor. The form assessed opinions as to the effectiveness, strengths, weaknesses, etc., of the system and courseware. The results were tabulated and analyzed to determine the overall suitability of the systems for the university curriculum. Results are provided in Table I, Summary of Users Evaluations of IV, and indicate that there is overall satisfaction with the systems and that group work is a viable alternative to individualized instruction (though individual use rated significantly higher than group responses in several areas).

In an IV laboratory area set up in the college, students, faculty, and others from throughout the campus were able to work with and learn about interactive video applications. This involved getting the equipment operational, finding a suitable location, and developing procedures and instructions which would allow the comfortable, secure, and efficient operation of the systems.

Macintosh HyperCard software was used to create interactive educational applications by faculty and students. Videodiscs were purchased for re-purposing and students learned how to use HyperCard to control discs. (Re-purposing involves writing a program to make an otherwise linear videodisc interactive, thereby allowing users to control a disc as they feel best.) The Instructional Technology Center worked with the project by providing demonstrations to all concerned of the use of HyperCard as it is used to control interactive videodiscs.

Student Involvement

Over 525 students were introduced to interactive videodisc technology in 16 classes and 8 different subjects, and about 225 of those students completed at least two of the programs during their classes. The system was used about 120 different times by individuals or pairs of students working in the laboratory for periods averaging about two hours. A structured program of instruction in hypermedia/interactive disc was developed and implemented through a Special Projects class. The interactive video system was also used in an International Programs Training Seminar through the International Center to teach ten foreign nationals about decision making and the nature of the interactive technology.

How Educational Programs Were Enhanced

Faculty and staff learned what interactive video can do, how it works, how it can be applied in their classrooms, and have begun to seek ways in which to integrate the materials into their curriculums. Faculty have been pursuing new grant proposals and other avenues for implementing additional interactive multimedia projects. Faculty continue to use IV in their classrooms, and the laboratory has become an ongoing function. The many students who participated have learned not only about interactive videodisc technology, but have benefited from the instructional content in starting their own business and improving oral and written communication. Cal Poly has successfully joined the ranks of those few CSU schools using this technology.

Evaluation of Individual and Group Users

Students and management workshop participants completed one or more interactive videodisc programs (*The Business Disc*, by Maryland Interactive Technologies (MITEC); *Oral* Communications, *Written Communications, and Decision Making*, by Wilson Learning Corp.). Active users (143) were asked to provide feedback by returning an evaluation sheet which sought to determine the extent of agreement on 24 questions about the courseware and IBM *InfoWindow* system. A scale of 5 (strongly agree), 4 (agree), 3 (undecided), 2, (disagree), and 1 (strongly disagree) was used to measure responses to 24 statements relating to satisfaction with the hardware and courseware.

Overall Profile of Users

The following characteristics of users were found using information on the surveys completed:

The total number of respondents = 143; Group = 113; Individual = 30.

The purposes for using the courseware were: fulfilling course requirements—44.37%; finding out more about the subject—11.92%; learning how interactive video works—23.18%; extra credit or special projects—18.54%; Blank—2%. Experience with computers. Non-existent—1.32%; Minimal—29.8%; Moderate—45.70%; Extensive—22.52%; Blank—1.32%.

Users previous knowledge of the subject matter: Non-existent—11.26%; Minimal—20.53%; Moderate—56.29%; Extensive—10.60%; Blank 1.32%.

Ages of users: 20 or below—5.96%; 21-30a—71.52%; 31-50—21.85%; Over 50—0.00%; Blank—0.66%

Educational attainment: High School—39.74%; Associate—10.60%; Junior 21.85%; Bachelor's 21.85%; Master's—1.99%; Doctorate—1.32%; Blank 2.65%.

Attitudes Toward the Courseware and Hardware.

Respondents were asked to indicate the extent to which they agreed or disagreed with each of 24 statements about the IV courseware (SA = strongly agree; A = agree; U = undecided or neutral; D = disagree; SD = strongly disagree) If an item did not apply, respondents were asked to leave it blank.

The respondents also answered questions regarding hardware and courseware features such as the ability to print out, to make to-do lists, the appearance of menus, the ability to interrupt the session without losing data, etc. Additional questions asked were: What would you say are the strengths of the courseware? What features could be added or changed to improve the courseware? What prerequisite knowledge is needed to best use this courseware? What was the approximate length of time it took to complete the courseware?

Results shown in Table 1 include mean scores for each statement for individual and for group users to measure the extent of agreement with the statements (level of satisfaction with the systems). The significance of the difference between group and individual means were calculated to determine agreement between the two types of users (whether one type of instruction was favored).

Over 525 learners were involved, individually and in groups. The *User Evaluation of Interactive Video* form was completed by a sample of 143 users. Compared with the hypothesized response of 3.0 (undecided/neutral) on a five-point scale, the average response scores were 3.60 for groups and 3.66 for individuals, indicating a high level of agreement and a perception of high quality and suitability of the hardware and courseware for use in the university business classroom. Groups agreed with 23 of 24 question at a significant level, and individual users rated 20 of 24 questions agreed positively at a significant level, reflecting an overall liking for the system. All group, and all but three individual, mean scores were 3.0 or above, also indicating a tendency to feel favorably overall about the courseware. This was reinforced by positive written comments.

In comparing the "group vs. individual" mean responses, significant differences were found to occur for 14 questions. Mean scores for individual users were significantly greater than for group users for six questions:

2. Individuals stated they enjoyed working on the interactive courseware significantly more than did groups.
7. Individuals felt they learned more than those using it in groups.
17. Individuals, more than groups, preferred working on IV courseware than listening to a lecture on the subject.
18. Individuals felt, more than groups, that they learned better than spending an equal amount of time reading a book on the subject.
19. Individuals felt, more than groups, that they learned better than spending an equal amount of time listening to a lecture on the subject.
20. Individuals felt more strongly than groups that the courseware would fit well as a module in a course which also uses traditional methods.

Mean scores for group users were significantly more favorable than for individual users for eight questions:

1. Groups felt information presented to be more accurate than did individuals.
3. Groups felt directions to be easier to follow than did individuals.
8. Group were more satisfied with the variety and flexibility built in to fit their needs.
9. Groups felt explanations about various concepts were clear more than did individuals.
13. Groups felt there was easier access to the appropriate place in the lesson when reviewing or changing responses.
14. Groups felt it to be easier to get back to where they left often when resuming a lesson after a break.
15. Groups felt the ability to go forward or backward was easier.
23. Groups felt that the program should be done more on an individual basis whereas individuals felt it could be done more in groups.

It should be noted that *The Business Disc* was used more by individuals and the other programs more by groups. This early version of *The Business Disc* courseware did not allow easy movement back and forth through the lesson as easily as did the other courseware, and question 15 regarding this attribute, therefore, was rated higher by groups than by individuals. Such differences in courseware made it more difficult to determine real differences in attitudes toward the entire system between group and individual means; courseware was a confounding variable in some cases. *The Business Disc* did not use the touch screen, and the low number of subjects using the touch screen on a group basis did not allow a statistical comparison of that feature. Weaknesses such as minor errors in program content and confusion in operating the programs were discovered. These were provided to the courseware developers, aiding modification of the courseware and procedures for using the materials.

The evaluation program extended over a period of two quarters, and specific recommendations were made for: integrating the programs into other courses, offering a series of programs for credit, determining whether to set up a full-blown laboratory for student use, and deciding whether to re-purpose existing videodiscs for interactive use. The overall feedback indicated that there is a place for this powerful technology in university business programs and that it can be favorably received by using either an individual or group approach.

The two three-hour workshop sessions were developed and taught with the assistance of faculty/staff from various departments within the University. Three IBM InfoWindow Systems with accompanying courseware, one Macintosh II using HyperCard to drive a videodisc player, and several Macintosh SE's with HyperCard were available for participants. Approximately 100 faculty and staff from a variety of areas on campus attended these sessions which covered the nature and use of IV systems and courseware, the means of producing new materials, industry uses of IV, and means of integrating IV into the curriculum. The workshops were hands-on, and were followed by individualized instruction to help in the application of the materials to the classroom. Thirty-five faculty/staff attended the first session, and forty attended the second, showing great interest in IV uses and the desire to become better informed about IV uses in their educational programs.

Table I
Summary of User Evaluation of Interactive Video Evaluation Form

Critical value of t where df = 143 overall. N = 113 (group); 30 (individual). The extent to which means differed from an expected 3.0 (undecided/neutral) mean or between group vs. individual are = * significance <0.01; ** significance < 0.05.

Expected response = 3.0 on a scale of 5 to 1.	5	4	3	2	1
	SA	A	U	D	SD

		Mean Score and Significance For and Between Type of Use		
	Statement	*Group*	*Individual*	*Group vs. Individual*
1.	The information presented was accurate as far as I could tell	4.3*	3.9*	*
2.	I enjoyed working on the interactive courseware	3.6*	4.2*	*
3.	The directions were easy to follow	4.2*	3.7*	*
4.	The experiences on the courseware related well to my real-life experiences	3.5*	3.5*	
5.	The video sequences held my interest	3.4*	3.7*	
6.	The computer screens were visually appealing	4.0*	4.0*	
7.	I learned a lot from this experience	3.4*	4.0*	*
8.	There was enough variety and flexibility built in to fit needs	3.6*	3.1	**
9.	Explanations about the various concepts were clear	4.1*	3.8*	**
10.	The amount of information is about right	3.6*	3.7*	
11.	The amount of time it took to complete the courseware was satisfactory	3.0	3.0	
12.	The touch screen (where applicable) worked well	3.7*	N/A	
13.	There was easy access to the appropriate place in the lesson when reviewing or changing responses	3.9*	2.4**	*
14.	It was easy to get back to where I left off when resuming a lesson after a break	4.3*	3.5**	**
15.	The ability to go forward and back is easy	3.9*	2.4**	*
16.	I preferred doing the IV courseware rather than reading about the subject in a book	3.7*	4.1*	
17.	I preferred doing the IV courseware rather than listening to a lecture on the subject	3.4*	4.1*	*
18.	I learned better than spending an equal amount of time reading a book on the subject	3.4*	4.0*	*
19.	I learned better than spending an equal amount of time listening to a lecture on the subject	3.3*	4.1*	*
20.	The courseware would fit well as a module in a course which also uses traditional methods	3.9*	4.2*	**
21.	The courseware would be desirable as an independent project for course credit	3.7*	4.1*	
22.	The courseware is good for non-credit courses mainly for personal growth or knowledge	3.9*	4.1*	
23.	This program should only be done on an individual basis	3.3**	2.8	**
24.	This program would (did) work well used in a group situation.	3.3*	3.4**	

Survey of CSU Interactive Video Usage

The survey of California State University (CSU) regarding interactive video resulted in a database of 41 users. A variety of systems including IBM, Sony, Macintosh, Apple II, or other were used, as well as approximately 60 different courseware packages. Sixteen were involved in re-purposing, 21 in full production, and 6 in partial production of courseware. The majority were interested in the possibility of disc-sharing and sharing experiences through workshops and seminars. Regarding its use in the curriculum, most used IV as part of course requirements, others used it as: extra credit, independent study, non-credit experiences, and credit for their role in the production of materials.

The results of the study aided in the implementation of a network of campus IV personnel and served as the basis for information dissemination, possible plans for joint purchases of courseware, or for disc-sharing. This type of cooperation could result in significant economies of scale and the optimization of efforts and funds. This objective was affected early in the project by the announcement of an Academic Computing Enhancement Institute (ACE) grant received by faculty at Cal State, Fullerton. This grant provided funds for an Interactive Videodisc Symposium to be held and part of its purpose was to aid in the development of a network. The Survey was provided to the sponsors of the ACE Symposium and aided them in inviting additional persons involved in interactive video usage.

Conclusions

This project was highly rewarding in that students, faculty, and staff throughout the university, in other CSU schools, and from other schools and colleges throughout the nation, (and internationally—10 International Program participants were involved) have learned more about this interactive technology and are likely to expand its usage in the future.

All goals of the project were realized beyond the point of expectation, and, since interactive videodisc usage should continue to expand as a result of this initial effort in the future, the funds allocated to the project were more than worth while. Without the support of Lottery Funds our campus would have been unable to take this exciting step forward in improving and enhancing instruction.

The findings indicate that interactive computer-based technologies can be used effectively for small groups, large groups, and for individualized instruction. Small groups allow good participation and interaction, the individualized approach is best for self-pacing, and large groups enjoyed the learning experience through a new and different kind of interaction. Strategies for implementing interactive instruction were successfully used to: allow fulfillment of partial requirements of a course, for extra credit, as independent study, as make-up for absences, and to learn through the development of new materials.

Users enjoyed the variety and flexibility of use, real-life simulation, and case analyses. They felt that the motion/sound kept their attention, that they were able to be active participants rather than passive, they preferred IV to reading a book and felt they learned more than in a similar amount of time on conventional instruction. It was made clear, however, from this project that using interactive technology in a university setting was a supplement, not a replacement for conventional instruction and that cost and ease of materials development were barriers to widespread adoption of interactive technologies.

New, simplified programming such as Apple's *HyperCard* (provides an easier way to move through and control videodiscs), and MacroMind's *Director* (allows production of animated sequences), along with the possibility of practical, erasable videodiscs (Smith, 1987) will help make self-produced interactive multimedia programs more feasible. These systems will not replace teachers, but will, like all technology, relieve instructors of repetitive tasks and free them to assist learners in more significant ways. Instructors must still understand the principles of effective instruction.

Interactive videodisc instructional systems involve a relatively new integration of computer and video technologies and as such require a significant transition period prior to their full acceptance by all but the larger firms in industry. The human element is essential as a key to the diffusion of technology throughout broad segments of society; and, IV is a high-tech approach to training, requiring time and effort for wide acceptance. Naisbett (1982, p. 35) states that "whenever new technology is introduced into society, there must be a counterbalancing human response—that is high touch—or the counterbalancing human response is rejected. The more high tech, the more high touch."

These high-tech approaches to training are needed partly, says Bill Morton, because today's younger workers, raised on TV, are "cynical about communications" and "simply don't enjoy reading." The only way to train them, he says, is with multimedia displays of sounds and sights (*It's a Video Age*, 1987).

The significant training advantages of IV are already recognized, and, as the availability and cost of hardware and courseware improve, the potential significant cost savings and efficiency of instruction will attract increasing numbers of industrial as well as educational users. For instance, the California State Department of Education, working with several state subject-matter experts, has developed a series of laserdiscs of low cost ($150 each), permitting further dispersion of this high-tech tool to high-school business education students. High-touch will occur as such inexpensive interactive videodiscs

Regarding the extension of IV applications to educational institutions, Bork (1986) suggested that, to make a real impact on the serious problems which exist, "we need to increase by many orders of magnitude our use of interactive technology-based courses in a bold new experiment." Nelson and Erwin (1985-86), however, warn that the organizational characteristics of higher education such as promotion and tenure, adaptability of material, and allocation of resources, need to be considered in implementing computer-assisted instruction courses, since education differs in many respects from industry.

In looking to the future, Daynes (1989), a founding father of IV, thinks that "things are going to be better, and probably smaller, cheaper, faster, and much more digital," paving the way for even wider dispersion of IV. Digital Video Interactive (DVI) and Compact Disc Interactive (CD-I) are being developed at present and offer the possibility of new ways to approach the interactive multimedia process (Berger, 1990). Economical recordable/erasable videodiscs will allow individuals to develop highly interactive programs at nominal cost. Scientists are compressing data to allow video to be shown directly from computer memory without videodiscs or tape, and virtual reality applications are attempts to totally involve the user's senses interactively. Developments which lower costs and make hardware and courseware more widely available can help revolutionize the way in which instruction is delivered.

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Paper (M1-05)

Virtual Classrooms: Video Teleconferencing Technology for Distance Learning and Training

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Abstract

The common factor in all distance learning and training is that the trainer and the learner are geographically distant from one another. This learning may be implemented in a number of ways ranging from correspondence schools via the mails to electronic delivery of voice, data, and video signals. Video teleconferencing technology was developed to provide two-way interactive conferencing between individuals geographically dispersed. It offers an alternative to face-to-face conferences where at least some of the individuals travel to a single site. This technology is easily expanded from the conferencee/conferencee structure to the instructor/student structure thereby creating virtual classrooms. While the technology provides exciting opportunities, it also creates a number of difficulties. This paper will discuss the basic technology, the application of the technology in distance learning, and some observations about using the technology in training and teaching.

Background

Tulane University is a major research institute located in New Orleans, Louisiana. The University offers undergraduate, graduate, and professional degrees as well as continuing education and development courses. Tulane recently purchased VideoTelecom CS350 equipment to implement two-way video teleconferencing across its various units. Presently there are three sites at which the video teleconferencing technology is employed as diagrammed in Figure 1. Site A is the main Uptown Campus and is about three miles from site B which is the Downtown Medical Center. Site C, the Delta Primate Center, is about 30 miles from site A. The University conducts research and teaching at other locations as well, e.g., the Business School offers MBA classes in Alexandria, Louisiana. There are plans to add these and other local and distant sites to this configuration in the future.

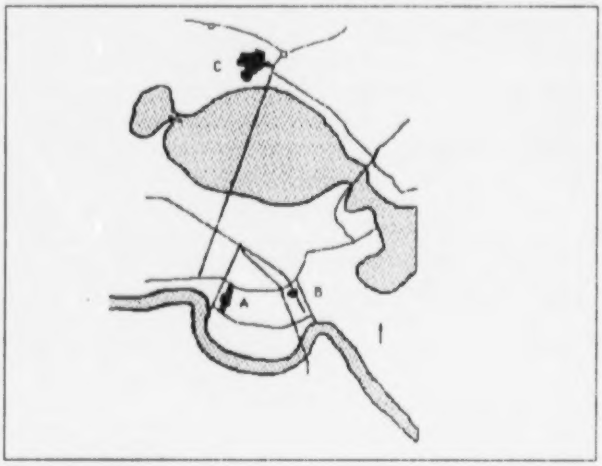

Figure 1. Sites

Technology

Figure 2 shows the video teleconferencing equipment located at each site. Camera 1 is a fixed camera and is usually set for a long shot that includes the entire group in the frame. Camera 2, located in the zoom box can be manipulated (Remote and Local) by either site. The sites can control movement of the camera up, down, right, left, zoom in or out, focus, and control the iris at both the local site and at the remote site. Camera 3 is affixed to a graphics stand which may be back lighted for viewing 35mm and larger slides. Audio is provided through two multi-directional microphones and a single speaker. By using the VCR, a site has the capability to transmit a prerecorded video tape.

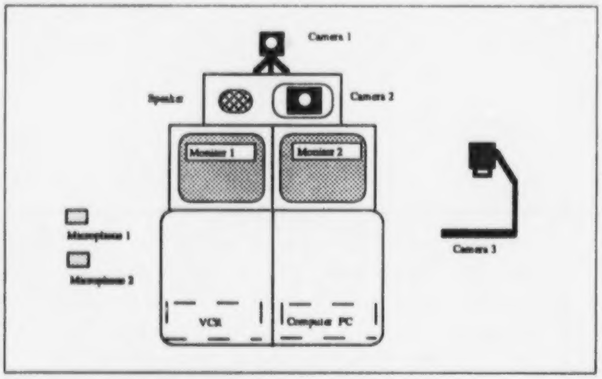

Figure 2. VideoTelecom CS350.

The sites select what is viewed on the two monitors, Preview and Main (Figure 3). The Main monitor can contain a local or a remote shot. In addition both local and remote sites can control either of the Main monitors by selecting cameras one though three or the VCR. The Preview monitor allows the site to view a shot before it is transmitted or to send a video slide. A slide is a high resolution video image, 518 pixel x 480 lines, containing detailed text, drawings, and/or a captured video image. The slide appears on the local site's and the remote site's Preview monitor simultaneously. Both sites can also simultaneously manipulate the slides, i.e. draw, write, or type on Figure 2. VideoTelecom CS350.the video slide. Slides may be captured and stored in a video slide tray to be transmitted at a later time. Therefore an individual may create slides before or at the time of transmission.

The codex functions, camera control and selection, are executed via the Pen Pal Tablet (Figure 4) or a hand held remote control. Drawing and annotation of video slides can only be carried out on the Pen Pal Tablet. Slide text is entered though a keyboard attached to the VideoTelecom's PC.

Besides the above equipment, each local site has a PC connected to the remote site PC via "PC Anywhere" software. This allows the output from the local PC to be displayed on the remote PC. The PCs are also connected to the campus network which then provides the capability to display commands, programs, and output from the IBM RS/6000 workstations, IBM mainframes, and CONVEX supercomputer as well as the PC.

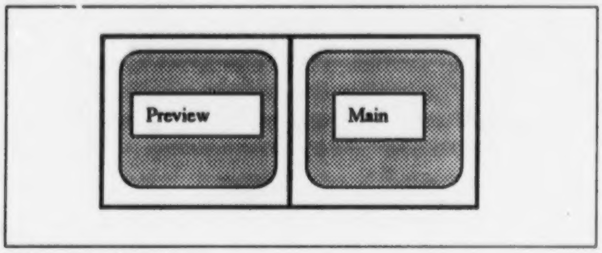

Figure 3. Monitors

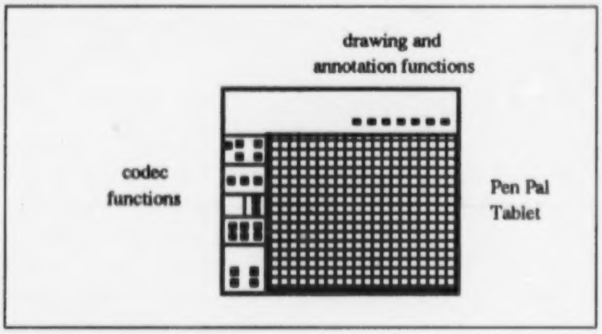

Figure 4. Pen Pal Tablet

Applications

The video teleconferencing technology is employed for both conferencing and Distance Learning (Table 1). Conferences between administrative personnel are scheduled on an "as needed" basis. Distance Learning can be subdivided into Courses and Training. Both credit and continuing education courses meet at the same time and day over an extended period of time, semester or part of a semester. Training classes between two and three hours long are regularly scheduled by the computing center for students, faculty, and staff covering introductory and advanced topics in mainframe and personal computing. Training classes are also provided by special request. There are variations of the above such as using the technology for "guest lectures" in a course or training that spans several days.

Video Conferencing Applications

- Conferencing
    - Conference
    - Lecture
    - Demonstration

- Distance Learning
    - Credit Courses
        - Semester e.g. 15 weeks
        - Guest Lecture
    - Continuing Education
        - Part of semester e.g. six weeks
        - Guest Lecture
    - Training
        - Single session
        - Series—multi session

Table 1. Applications

With the exception of a true conference, the above applications may or may not have an audience at the originating site. For example a training course may have the instructor at one site with all the students at the remote site or the instructor and some students at the local site with other students at the remote site.

Conferencing

Conferencing applications are not the focus of this paper and will not be discussed at this time. They do, however, increase the overall usage of the technology and therefore spread the cost of the technology over a broader base. Teleconferencing also tends to be utilized by higher level managers who are then more supportive of other video teleconferencing ventures.

Distance Learning

The common factor in all distance learning, courses and training, is that the trainer and the learner are geographically distant from one another. Distance learning is not a substitute for face-to-face teaching. It is an alternative to not receiving the instruction, or receiving the instruction at a high cost in time and money.

When a location does not have the expert resources to offer a particular course or training there are three options: the instructor (resources) must travel to the students, the students must travel to the instructor, or the students must do without the instruction. If students must travel to a distant site for instruction, the overhead of traveling must be calculated into the education or training cost. There is the actual cost of transportation, sometimes lodging and food, and the lost productivity while the student is in transit. When the instructor must travel to a remote site there is also this overhead to consider in the calculation. On-site instruction at remote locations usually requires a critical mass of students to justify the cost. If only a few individuals are in need of a course then they must wait sometimes for extended periods of time before the course can be scheduled. In some cases the critical mass may never be reached and the instruction is never offered.

Course delivery through distance learning provides a means of bringing the student and the instruction together. There are a number of alternative methods of providing course delivery (Table 2).

Books	Correspondence courses
Audio	One way, e.g., radio or sound recordings—two way, e.g., telephone
Video	One way, e.g., broadcast or video tape; video one way with audio two way; two way video and two way audio; Interactive video
Computer based	CBT

Table 2. Alternative Delivery Methods

Two way video conferencing has many advantages over the alternative delivery methods:

- Structure—it provides a structured learning environment where the student is expected to attend classes and complete work on a scheduled basis.
- Feedback—it provides feedback from another person in the familiar traditional manner.
- Speed—it provides almost instantaneous delivery and feedback.
- Questions & Answers—it provides an opportunity for both the student and instructor to ask questions and receive answers.
- Audio & Visual clues—it provides an opportunity for both the student and instructor to send and receive audio and visual clues, e.g., emphasize a point, show concern, puzzlement, comprehension, establish rapport, etc.
- Demonstrate—it provides for visual demonstration of concepts, procedures, programs, etc.
- Graphics—it provides the capability to send and manipulate graphics.
- Flexibility—it provides almost unlimited flexibility to adjust the training to meet individual and situational needs.

However, two-way video teleconferencing is not without its difficulties or disadvantages.

- Cost—the technology requires a high initial investment and regularly occurring operating expenses.
- Environment—dedicated sites must be prepared and maintained to house the equipment.
- Technical difficulties—transmission problems and equipment failures can disrupt class presentations.
- Trained technicians—individuals trained in the operation and maintenance of the equipment are required at each site.
- Appropriateness—not all courses lend themselves to the technology and not all instructors are comfortable with the media.
- TeleTeaching—teaching must accommodate the special nature and limitations of the technology. It requires special training in video teaching techniques.
- TechniPhobi—student and/or instructors may initially feeluncomfortable or unwilling to use the unfamiliar technology.

Observations

After each training class the students are asked to complete a Short Course Evaluation form (Appendix A). The instructor and any observers are asked to write an informal report after each class. These evaluations and reports are then shared at regular meetings. The following are observations made during teleconferencing classes by instructors, students, observers, and myself.

Site—The rooms to be used at each site should be prepared especially for video teleconferencing. Walls should be a neutral color, not white, as white walls and white boards cause high contrast in the picture. Also, care must be taken to avoid a reflected cast from colored walls and large objects, e.g., green faces. The rooms need bright and even lighting. Room size and shape is also important. In rooms without proper depth it is difficult to include the entire group in a frame. This leads to the need to continually pan around the room in order to be alert for questions and to view the individual who is speaking. Rooms with too much depth make it difficult for those in the rear of the room to see the monitors.

Training—It is important for the instructors to receive training in two areas. First, the instructors should be thoroughly trained in the operation of the equipment and minor troubleshooting of equipment problems. It requires at least two days of practice to smoothly operate the equipment while teaching a class. Second, the instructors should also be trained in teleteaching techniques, i.e., what constitutes effective teaching for this type of medium. Instructors have noted that it is difficult for them to use body language and establish eye contact with the class in the traditional sense. Also, they have noted that it is difficult to hear all the subtle exchanges that would normally alert them to student concerns, problems, and topics that need further clarification.

Transmission—Use a high speed T1 line or microwave to transmit between the sites. A low transmission rate will cause movements to appear jerky, and will result in a freeze frame while a slide is being transmitted. This can be distracting (as well as comical) to the students and the instructor. Also, thoroughly check the connections at each of the sites. Loose connections will cause video slides to contain extraneous images, random vertical and horizontal rectangles, during transmission. Unreadable slides are useless for conveying information and annoying to the students. Retransmitting the slides will usually eliminate the problem but this interrupts the flow of the class.

Class Materials—Graphics and other class materials which are to be transmitted should be previewed to determine how they will appear on the monitor. The material will be viewed by the students on a monitor and so must appear clear, readable, and uncluttered. Instructors should think of their material in terms of screens. It is preferable to use prepared graphics and video slides rather then writing on a black or white board. White boards have high contrast and it is difficult to keep the writing in the frame. Copies of critical material should be distributed to the students in hard copy in case of transmission problems. Arrangements need to be made ahead of time to deliver and distribute class handouts at the remote site.

Interaction—Before beginning a video conference class the instructor should give a quick introduction to the equipment, explaining and demonstrating what each site sees and hears. This helps to overcome concerns when the audience is initially unsure about the equipment and the video conferencing process. To overcome feelings of distance or alienation participants should introduce themselves. Also, when possible, the instructors should use the students' names when asking or answering questions. It is sometimes a problem for instructors to establish rapport with the students via the technology. It requires training and practice to make eye contact with a camera. A separate on-air monitor will help the instructors view themselves while giving their presentation.

Personnel—If there is no audience at the originating site then it is possible for the instructor to operate the equipment while teaching. It is more difficult to operate the equipment and teach if there are students in the same room. An assistant may be employed to manage graphics and slides while the instructor controls the cameras via the hand-held remote control. The instructor should determine what is to be transmitted and the flow of the presentation. The remote site will need an individual to be responsible for turning on the equipment, checking and making equipment adjustments, distributing materials, and other tasks.

Preparation—Teaching via video teleconferencing requires more preparation than teaching in a face-to-face situation. Visuals need to be prepared and tested before class. A clear outline and organization are essential to smoothly switch from visual to visual while teaching. It also seems to require more concentration to juggle all the components while teaching via the teleconferencing technology.

Equipment—The addition of the PCs at each site allows for demonstration of micro and mainframe programs, commands, procedures, and output. The best configuration is adding a third monitor rather than using one of the two standard monitors. Three monitors translate into less switching by the instructor, e.g., the students can simultaneously view the instructor, a visual, and the computer session.

Overall—The Short Course Evaluation form completed at the end of each training class does not ask if the student prefers the teleconference course to a traditional, face-to-face course. The evaluation form does ask

- "How willing would you be to attend another video conference short course?"
- "Given a choice between traveling Uptown to attend a short course and attending a video conference course, would you: Travel or Attend video course?"
- "Given a choice between attending a video conference course and waiting four weeks for an on-site course, would you: Wait or Attend video course?"

The overall comments from the students, instructors and observers have been positive. Students like the convenience of the teleconference classes and the expanded variety of courses available. Some students have stated that they find it easier to concentrate using the technology. The instructors have enjoyed the novelty of teaching with the equipment and have found the experience stimulating and challenging.

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APPENDIX A
SHORT COURSE EVALUATION

COURSE TITLE: DATE:
INSTRUCTOR:

1. Please rate each of the following items on a scale of Excellent to Poor:

	Excellent				Poor
Clarity of Visuals					
Clarity of Audio					
Relevance of Video to discussion					
Ability to follow discussion					
Demonstration of procedures					
Use of examples					
Ability of instructor to establish contact with audience					
Relevance of printed material to discussion					
Opportunity for questions					
Degree to which **course** objectives attained					
Degree to which **personal** objectives attained					

2. How willing would you be to attend another video conference short course?

Very willing				Not at all

3. Given a choice between traveling Uptown to attend a short course and attending a video conference course, would you:

Travel ____
Attend Video course ____

4. Given a choice between attending a video conference course and waiting four weeks for an on-site course, would you:

Wait ____
Attend Video course ____

5. Overall, what do you feel were the **strong** points of using video conferencing for presentation of the short course?

6. Overall, what do you feel were the **weak** points of using video conferencing for presentation of the short course?

7. In general, how would you compare the video conference course with a live on-site course?

8. How could we improve the video conference short courses to make them more effective in the future?

9. Additional, general comments.

Projects (M1-06)
Community Partnerships

A School-University-Corporate Partnership: View from the Second Year

Nancy Hunt
California State University, Fresno
Fresno, California

Abstract

In the spring of 1990, the California State University, Fresno's School of Education and Human Development and the Clovis Unified School District proposed a curriculum development project to the IBM Corporation. In exchange for the provision of IBM equipment, the project called for the applicants to develop lessons and staff development materials which integrate use of interactive laserdiscs into the California's History/Social Science Curriculum Framework.

The project began in January, 1991, with teachers being inserviced on how to use laservideo discs and how to develop hypermedia lessons. During the spring 1991 semester, six teachers worked cooperatively to prepare computer-based interactive social studies lessons appropriate for their classroom. At the close of the academic year most of the lessons were still in an incomplete or "first draft" stage.

School-wide inservices on IBM's I-Class network and Microsoft Works were held early in the second year. A followup inservice on hypermedia was held in November. Interest in hypermedia was further revived in the spring of 1992 by a student's History Day project and the promotion of a student computer art contest.

This presentation will outline the project's progress, from inception through implementation and formative evaluations. Successes, disappointments, and "lessons we have learned" will be shared. The presentation will feature a sample of the projects created by the participants and their students.

Come Get the FACTS: Families and Computers Together in Schools

Celia Einhorn
TNT Technology and Training
Tijeras, New Mexico

Abstract

The Division of Continuing Education and Community Services of the University of New Mexico in collaboration with the Albuquerque Public Schools presents FACTS, Families and Computers Together in Schools. FACTS is a family learning model for students, ages 5-95. The program uses computer technology to enhance family literacy fun. Technology in community programs demonstrates the creative learning opportunities educational technology provides.

Instructors have found that technology as a valuable tool has changed, not only the way families view learning, but has also changed the way they view themselves: with self esteem and self respect that come from discovering and developing their strengths and abilities in rewarding ways. The certified public school staff teach utility software, word processing, database, multimedia software and educational simulations. The instructors meet with families six weeks, two hours a week, evenings.

Each activity expands family literacy skills and further develops interest in learning, for success in school as well as success as it relates to the rewards of productive and stable family relationships. These technological, intergenerational, and shared activities promote life long learning, and model positive learning. Parents, as avid computer users, are taking active part in their children's education. This program was also earmarked for Chapter I and Special Education parents who may not have strong literacy skills and often feel isolated from their child's education.

Linking the High School and the University: A Tale of Computers and Writing

Gail Grejda
Clarion University
Clarion, Pennsylvania

Abstract

The purpose of this presentation is to share results of a collaborative effort between three college professors and six high school English teachers which impacted in a positive way the curriculum of each.

The project stemmed from a shared perception that (1) composition instruction is experiencieng a fundamental change in perspective and instructional practice, from the traditional model of writing-as-product to that of writing-as-process, and (2) the impact of computer technology has revolutionized the ways in which writing is taught and learned.

Computers facilitate the development of a discourse community in the writing classroom: (1) the computer transforms the traditional classroom into a composing workshop where students spend class time writing, talking freely about their writing and copiously revising their papers; (2) student/teacher roles and expectations are redefined with teachers assuming the role of facilitators and encouraging students to experiment with language, take risks, and give and receive help from peers; (3) the emphasis of the writng curriculum shifts from lectures to teaching the process of writing; (4) because students are immersed in the process of writing, the focus of the writing curriculum is the acquisition and honong of higher level thinking skills.

The objectives of this project addressed and answered concerns of both the University and the High School.

The Playing to Win Network

Laura Jeffers
Playing To Win, Inc.
New York, New York

Abstract

Abstract not available at press time

Special Presentation–SCS (M1-07)
Using Technology as a Tool to Support Middle School Inquiry Math

Richard Carter, John Richards, Bruce Mallory
Bolt, Beranek and Newman
Cambridge, Massachusetts

Abstract

In this session we will share materials from three teacher development projects aimed at helping middle school mathematics teachers understand and implement a technology-based inquiry approach to mathematics as advocated in the NCTM standards. We will share examples of inquiry-based activities using calculators and computers in the areas of primes and factors, functions, and graphing equations. We will show a videotape of students doing a technology-based inquiry activity called Connectany. We will also share a self evaluation tool called the component checklist that we have developed to support inquiry-based classroom work, as well as some of our experiences in trying to help teachers with the process of change.

Projects (M1-08)
Adaptive Access and Curriculum Incorporation

They Gave Me All of This, Now What Do I Do?

Charles Cravens
Groves, Texas

Abstract

With the use of more and more adaptive and assistive devices, teachers can be overwhelmed when presented with new equipment. This brief presentation, will demonstrate the installation, and immediate use of the Adaptive Firmware Card and Unicorn Expanded Keyboard with the Apple //e Computer. Software solutions will also be discussed. If time permits, audience questions will be addressed. The goal of this presentation is for the teacher who has no experience in this area, will be able to find an immediate use for this equipment.

See That Mac Sing

John Fluth
Region V E.S.C.
Beaumont, Texas

Abstract

Demonstration method using computer software and hardware to allow a Macintosh computer to "sing" with a human voice while interfacing through Ke:nx with a Unicorn Board and high-contrast graphics on a computer monitor. Methods to use this technology with students whose visual and hearing acuity is unknown will be discussed. Handouts will include details on how to duplicate these methods. Presentation will be made by regional adaptive technology specialist, and regional specialist for students who are visually impaired. Multi-media presentation will show direct application of this technology in use with low or unknown visual acuity, or low or unknown auditory perception.

Incorporating Technolgy into a Whole Language Approach

Melanie Bacom
Bridge City, Texas

Abstract

Abstract not available at press time

Projects (M1-09)
Desktop Publishing

School Newspapers: Simple and Successful

Libby Alexander, Marsha Fawns, and Theresa Overall
The Lamplighter School
Dallas, Texas

Abstract

Newspaper production gives students a sense of accomplishment and ownership, plus experiences in every language arts area. Cooperation, problem solving, critical thinking and active learning are part of every phase of production: planning, interviewing, listening, writing, editing, and doing layout.

After an introduction to journalism, reporters are assigned "beats" based on their choices. Students compose and edit their articles at the keyboard. Completed articles are printed, organized in a layout and photocopied for school-wide distribution.

Since 1987, Lamplighter School's second grade has published a newspaper. Each year the process has been improved. Using computers for production was the biggest refinement in 91-92 allowing students more control over publication with increased ease and creativity.

Next year, we hope to:

1) Give the students more control (accumulation of articles into one document for layout, cut and paste features)
2) Utilize more of the computer's power as a tool for simplifying work and increasing thinking (spelling and punctuation checks)
3) Maintain features of current software (ease and simplicity of use, appropriate reading levels for directions, mouse and keyboard control)

Practice What You Teach: Developing a Copyright Policy

Brian Kissell
Webster Intermediate School
Houston, Texas

Abstract

One of the many jobs of teachers is to teach ethical behavior, and a respect for the law. Whether we like it or not, our students look at us and model our behaviors and attitudes. A large number of teachers are unknowingly giving their students the wrong role model to follow in regards to copyright laws. With the increased use of technology in the schools, it is becoming easier to violate copyright laws.

School districts that have not already done so should begin the process of developing a consistently policy regarding the use of copyrighted materials.

This session will briefly outline concerns that should be addressed when developing and implementing a district policy that will be a meaningful part of the entire school curriculum.

Impact Your School Through Desktop Publishing

Ken Uckotter
The Summit Country Day School
Cincinnati, Ohio

Abstract

One of the characteristics of a successful school is that its graduates are confident in the skills they've acquired, and key among these skills is the ability to communicate effectively with the written word. In our information society we know that our students must be good communicators, comfortable with the fact that the base of knowledge is expanding geometrically, and comfortable with the new "pencil" of the 21st Century, the computer.

At The Summit Country Day School, we strive to do more than teach our students to write well. Computer technology is used effectively to enhance a "process writing" approach throughout our school. Students learn to add creativity to their projects in ways that develop their skills as *desktop publishers* of their own work!

We've had wonderful success at our K-12 school. Students use Macintosh computers, scanners, video cameras, and laser printers to add quality and creativity to their papers, projects, and newspapers. Examples from every level will be discussed.

Impacting your school by utilizing desktop publishing principles can have a dramatic and energizing effect on a school! We'll share our approach and techniques.

Introduction to PageMaker—Macintosh

David L. Henderson
Sam Houston State University
Hunterville, Texas

Abstract

Desktop publishing (DTP) is coming of age in businesses and in schools. There are programs available on the Macintosh and IBM computers to produce flyers, brochures, books, newsletters, manuals, etc. The teacher can produce everything from classroom materials to newspapers with the proper equipment. General hardware requirements are a Macintosh with 2M RAM, 40 M hard disk, and a laser printer or the inexpensive ink-jet printer and the program *PageMaker*.

Projects (M1-10)
ESL/ESOL

Reading HyperText: Reactions to the New Technology

Isabel Vallejo
University of Texas at El Paso
El Paso, Texas

Abstract

This project studies how ESOL students use a hypertext system. For this study, a hypertext program is being developed using Hypercard. The theme of the text is the discovery of America, specifically, the voyages made by Christopher Columbus to this continent. It consists of five basic units: text, definitions, references and bibliography, scaned images, and biographies. All the modules contain reciprocal links. The main text itself is divided into small modules or nodes that present small quantities of information. There are three main topics: the preparation of the trip, the four voyages of discovery, and the contoversies around the discovery. Each main topic is also divided into sections, each covering one theme. This gives the users the option to navigate through the information according to their interests, and avoid sequentiality.

Intermediate and advanced level ESOL students will be observed as they work and read within the hypertext. They will be videotaped individually while working on the computer. The core of the observation will be the steps they follow to read the text; and the way in which they react when reading on a computer. All their movements and access to the system will be transcribed and analyzed to answer several questions related to the influence that hypertext has on reading habits.

Implementing a Multimedia-based ESL Curriculum

Dolores Moore
Littlefield, Texas

Abstract

Abstract not available at press time

Language Experiences: The Computer Connection

Sue Espinoza
Texas Tech University
Lubbock, Texas

Abstract

One growing area of interest today is the field of literacy–for students as well as adults.

As the United States strives to provide opportunities for all of its inhabitants to develop appropriate levels of English language literacy, the challenge to educators is great. Computers and computer software can be invaluable as aids to promote language development, often at the same time that they provide content instruction or reinforcement.

This session will present descriptions and examples of computer programs that have been used to promote language skills development. The presenters will provide specific hints for using these programs with special need groups of students, including those who are at risk due to a lack of English language proficiency. A video and samples of student work will be presented, and a bibliography of programs will be available.

Hyper–Acculturation, Miami Central's Apple Crossroads Grant

Ivy Montoya
Miami, Florida

Abstract

Abstract not available at press time

Special Presentation–ISTE (M1-11)

Electronic Information Organizers Promote Studying and Learning Across the Curriculum

Lynne Anderson-Inman, Mark Horney, Leigh Zeitz
University of Oregon
Eugene, Oregon

Abstract

This presentation will describe the use of computer-based information organizers as tools for studying and learning content are material. Two types of information organizers will be shared: electronic outlining programs and electronic concept-mapping programs. These programs are effective tools for studying because they help students to organize and manipulate information in ways that are personally meaningful and that reflect their growing understanding of the material to be learned. The programs are also effective because they facilitate active student involvement and encourage personal responsibility for the learning process. Using ideas obtained from three years of federally funded research in secondary schools, we will describe and illustrate effective study strategies for using both types of information organizers. In this presentation we will demonstrate the two types of programs, describe strategies for studying and learning with each type of program, show examples of how teachers have used the programs in a variety of disciplines across the curriculum, and offer implementation suggestions to teachers who would like to use computer-based information organizers in their classrooms.

Projects (M1-12)
Cognitive Issues in Multimedia

Traversing a Hypermedia Infoscape: Patterns of Student Use

Randall Boone and Kyle Higgins
University of Nevada, Las Vegas
Las Vegas, Nevada

Abstract

Student paths through hypermedia reading materials, in the form of adapted basal reader texts, were recorded and collected for a group of 100 elementary school students over a period of three years. These materials were designed for unsupervised exploration of the text by students. Hypermedia enhancements, in the form of text windows, graphic windows, graphic overlays, and digitized speech, music, and sounds, provided help for vocabulary words, phonic and structural analysis skills, anaphora (e.g., pronoun/antecedent relationships), and comprehension.

Data analysis indicates:

The number of enhancements accessed during a single lesson. Over the course of one school year student access of enhancements varied from lesson to lesson but remained relatively consistent from the beginning to the end of the year. This suggests that student enthusiasm for using the lessons did not wane over the course of the nine-month school year. This conclusion is corroborated by student and teacher surveys.

Time spent engaged with enhancements. Students had complete control over the amount of time that an enhancement was visible. Generally, these times were of a reasonable duration for the particular task involved (e.g., reading a small amount of text or viewing a graphic). Also, total time spent on a particular page usually was of long enough duration for students to have read the page in addition to viewing the enhancements that they selected for that page.

Order and repetition of access of enhancements. During protocol analysis sessions, students accessed the enhancements in the order that they appeared in the text. This was not a strategy taught to the students.

Protocol analysis of student perceptions of lesson enhancements. All students verbalized an understanding of the hypermedia interface, the connection between the word selected and the information shown in the enhancement, and the correlation of textual definitions, graphics, and graphic overlays to their respective words in the text. Students indicated that they understood and enjoyed interacting with the comprehension enhancement.

Product as Assessment—Hypermedia for Woolgatherers

Mary K. Brown and Eadie Adamson
The Dalton School
New York, New York

Abstract

In an environment that requires a linear output, depth of knowledge is often discouraged. Children are continually reminded to "get to the point" or "stick to the subject." "Substantiate your argument" is the order of the day. Youngsters with a tendency to global thinking patterns are at a disadvantage in direct proportion to the amount of additional information they can bring to bear on a topic. Moreover, these youngsters may need explicit contextual materials at hand in order to produce a linear line of reasoning. Hypermedia acts as a context creator and *aide memoire* for the global thinker as well as the unfocused learner. When student output is in the form of hypermedia instead of "research paper," teachers have new ways of assessing the kinds of learning and thinking that have actually taken place. Student-created reports based on the Archaeotype experience–a computer simulation of an archaeological excavation authored by the presenter–will be presented and discussed.

Developing Teacher Skill in Improving Student Thinking Using Interactive Videodisc

Bruce Ledford and Terrance Rucinski
Auburn University
Auburn, Alabama

Abstract

This project presentation describes an integrative framework for incorporating the past fifteen years of research on teaching and learning and the development of a Level 3 interactive videodisc to be used in an inservice format for teaching strategies for improving student thinking in content built on the framework.

The integrative framework, an instructional model called Dimensions of Learning (DOL) (Marzano, Pickering, Arredondo, Blackburn, Davis, & Ewy, 1989), integrates the past fifteen years of research on teaching and learning, and presents a way of viewing teacher decisions about instructional situations from the perspective of the student. DOL is based on the premise that learning content material requires rigorous thinking about content, and is a direct outgrowth of efforts by the Association for Supervision and Curriculum Development (ASCD) to develop a comprehensive framework for teaching thinking. The DOL model was field tested by eight-five participants from seventeen schools or school districts across sixteen states and two countries.

In the first phase of this research project, the researchers designed and produced a Level 3 interactive videodisc for use in training K-12 teachers (in all subject areas) to use the DOL framework to integrate the teaching of content material with thinking processes. This production involved coaching teachers in use of the DOL strategies, video taping appropriate use of strategies in classrooms, and programming the computer to manage the taped segments as wall as the tutorials and simulations.

Designing Developmentally Appropriate K-8 Hypermedia Materials: Qualitative Sequencing Studies Results

Judi Harris and Neal Grandgenett
University of Nebraska at Omaha
Omaha, Nebraska

Abstract

Informational "webs" presented for exploration in hypermedia format are often designed by software manufacturers without careful consideration of the development of children's associative thinking processes. The resulting interactive hypermedia packages may be appealing to the adults recommending them for purchase, but may not be developmentally appropriate for the children using them.

How might interactive hypermedia materials for children be designed to be developmentally appropriate? To determine the potential existence of a developmental sequence of specific association types among children, the free-form concept maps of 292 students in grades 2 through 8 in a mid-sized midwestern city were collected and coded according to numbers of semantic relationships displayed. Seven of fifteen possible association types were positively correlated with age:

- Attributive ($r=.237, p<.01$),
- Component/Aspect ($r=.334, p<.01$),
- Contingency ($r=.353, p<.01$),
- Exemplification ($r=.208, p<.01$),
- Class Inclusion ($r=.259, p<.01$),
- Synonymy ($r=.210, p<.01$),
- and Person-Related ($r=.214, P<.01$),

and two of the fifteen types were negatively correlated with age:

- Operational ($r=-.534, P<.01$),
- and Comparison ($r=-.308, p<.01$)

Minimal gender differences and teacher effects were also observed. The age-related development of these different association types will be reviewed during this project presentation, along with the researchers' impressions of how this sequence, once firmly established, could inform the design of interactive hypermedia materials for children.

Projects (M1-13)
Higher Ed Applications

Metaphor and HCI

Neville Stern
Royal Melbourne Institute of Technology
Melbourne, Victoria

Abstract

Abstract not available at press time

Experience Using a Student Response System in Post-Secondary Technical Instruction

Dennis R. Short
Purdue University
Purdue, Indiana

Abstract

This paper discusses the implementation, programming, and utilization of a Student Response System (SRS) in a technical education laboratory. Examples of materials and integration of the system into a paperless grading environment (automatic linkage to Excel spreadsheets) are discussed. Instructor and student response to the system are examined both quantitatively and qualitatively. Implications for pedagogy and design of instruction is addressed. Particular attention will be made to synchronous versus asynchronous test administration. Additional topics will include SRS application to distance education and formulation of plans for a large (474 seat) lecture hall implementation.

The specific system discussed is IBM's Class Room Presentation Option utilizing Asymetrix's Toolbook under Windows 3.0. The equipment and software used to support this paper were obtained under a Study Grant from IBM's Academic Information Systems (ACIS) group.

Organizing a Hypermedia Development Team Alias: The Transcontinental Stack Team

Susan Cooper, Frank Slaton
California State University, San Bernardino
San Bernardino, California

Abstract

Development of successful curriculum materials has always involved the integration of team efforts. This Project Presentation outlines an effort involving educators in California, Florida and Texas. California State University, San Bernardino has begun developing a multimedia timeline study of the final 100 hours in the life of President John F. Kennedy. The multimedia presentation traces the presidential trips across Florida and Texas, ending tragically in Dallas in November of 1963.

Team members consist of subject matter specialists as well as technical specialists. This timeline study draws on a wealth of resource material such as maps, photos, newspaper articles and interviews. Students at the university and high school levels and their teachers are involved in the research and development of this multimedia product through participation in the Christopher Columbus Consortium (a partnership involving Apple Computer, universities and K-12 schools).

It is our intent to create a HyperCard stack with laser disc links for classroom use at the middle and high school levels. The presentation will describe the "transcontinental stack team"'s organizational efforts and progress toward reaching that goal.

The E-RBR (Electronic Reserve Book Room)

Richard Goodram
San Diego State University
San Diego, California

Abstract

Abstract not available at press time

Special Window (M3-01)

Education, Computing, and the Superconducting Super Colliding Project

Sherri "Sam" Kivlighn
Director of Computing, Superconducting Super Collider Computer Division
Dallas, Texas

Abstract

The Superconducting Super Collider Project is arguably the most exciting scientific initiative currently in progress and it promises to open new windows on the world of matter itself. Two perspectives of immediate interest arising from the project will be addressed in this session: education and computing. Discover the spectacular opportunities this project holds for education and educators, and find out what roles compuitng, computer science and computer scientists play in this ambitious, international effort.

Special Window (M3-02)

Instruction: The Emerging Roles of Educators

Alan November
Technology Consultant
Glenbrook, Illinois

Abstract

During the past three years, the Christa McAuliffe Institute for Educational Pioneering has examined the professional culture of schools. This effort has led the Institute to identify seven emerging roles for teachers: broker, collaborator, entrepreneur, long range planner, mentor/mentee, researcher and seeker. These roles imply a fundamental change in the way that both veteran and prospective teachers are trained and evaluated and how the curriculum is developed. As educators develop these roles and others, the culture of schools as working and teaching communities will also evolve to help better prepare our students to manage their future.

ADAPT Kickoff (M3-03)

Legal and Administrative Issues Related to Adaptive/ Assistive Device Utilization in the School Setting

Mary Cole
Texas Education Agency
Austin, Texas

Abstract

Abstract not available at press time

Special Window (M3-04)

Low-Cost Computer/Radio/Satellite Systems: New Vitality for Education

Greg Jones
University of North Texas, University of Surrey Satellite Research Unit
United Kingdom

Abstract

With the increasing role of radio/satellite communications in the world, schools are turning to the use of inexpensive radio and satellite technology to provide additional curricular activities for their students. This special session will provide an overview of the potential uses of amateur radio and satellite technology as an alternative to traditional telecommunications activities. It will also provide examples of ways to utilize this exciting new avenue for cross-curriculum integration.

Panelists:

Robert Diersing
Texas A&I University
Corpus Christie, Texas

Jeff Wallach
Dallas Remote Imaging Group
Carrolton, Texas

Doug Loughmiller
Amateur Satellite Consortium, Inc.
Paris, Texas

Special Presentation–Panel (M3-05)

The Role of Object-Oriented Development Techniques in Computer Science Education

John McGregor, Moderator
Clemson University
Clemson, South Carolina

Abstract

Participants will discuss the results of the research workshop of the role of object-oriented technology in computer science education that will be held in conjunction with NECC '92. The workshop will consider how object-oriented techniques can best be integrated into secondary, university, and corporate computer science education programs. It will also consider materials and techniques that are appropriate for teaching about object-oriented development techniques. Object-oriented techniques can be more difficult and time consuming for small short-term projects, such as assignments in courses, that the procedural approach. This workshop will consider how to give students appropriate experiences in the context of the time periods typical of an educational setting. In the panel session during the NECC Conference, researchers will discuss the workshop activities and conclusions that were made on the issues..

Paper (M3-06)

As The Disc Spins: Optical Media In Education

Ann Barron
University of South Florida
Tampa, Florida

Abstract

Because of their durability and large storage capacities, optical media are playing an increased role in education. New acronyms and applications are appearing in journals and marketplaces on a regular basis, making it difficult for educators to keep up with of the latest developments. This paper is designed to provide an overview of several technologies utilizing optical media, including Interactive Videodisc (IVD), Compact Disc-Read Only Memory (CD-ROM), Compact Disc Interactive (CD-I), Commodore Dynamic Total Vision (CDTV), Digital Video Interactive (DVI), and QuickTime. Advantages and disadvantages for each topic are outlined and educational applications are discussed. In addition, configuration requirements for each technology are illustrated.

Interactive Videodisc (IVD)

Interactive videodisc (IVD) is an example of a technology utilizing optical media. The laser videodiscs are generally 12 inches in diameter and store analog video. The advantage of videodisc storage (as opposed to videotape) is that it can "freeze frame" an image for an unlimited period of time. In addition any frame on the disc can be accessed immediately without the need to "fast forward" or "rewind."

The most common format for educational videodiscs can store 30 minutes of motion video on each side of the disc along with two separate audio tracks. The video can also be accessed by individual frames—up to 54,000 pictures on each side of the disc. Videodiscs can be controlled by a remote control unit, a barcode reader, or an external computer.

IVD Applications

There are many applications for videodiscs in education. For example, videodiscs offer a tremendous source of outstanding, yet inexpensive movies and educational documentaries. They can easily replace the 16mm film libraries at a fraction of the cost without worries about sprocket holes and rewinding! Even compared with videotape, discs have many advantages. For example, videodiscs don't wear out or degenerate with use, and they are much easier to store. In addition, many educational films are available on videodisc at prices much less than on videotape.

Some videodisc programs are designed in a tutorial strategy wherein new information is introduced and questions are presented to reinforce the instruction. With the ability to branch easily to any segment on the disc, the student is not "locked" into a particular sequence and can receive additional instruction based on his/her performance.

Instructional videodisc games offer an effective means of maintaining the interest of a generation of children who have grown up with video arcade games. Educational games usually offer a variety of special effects and motivate students with the challenge of solving a mystery or beating the "clock," other students, or the computer.

The best way to describe a new breed of programs is to call them multimedia libraries. These applications are not designed to teach—at least not in the customary tutorial fashion. Instead, they offer a wide array of interrelated information in video clips, still frames, sound, maps, text, and graphics. Users can interact in any number of ways and with a multitude of approaches to investigate their interests and create their own video reports.

Another educational videodisc application is visual databases, which consists of a series of still frames. Visual databases can be equated to a slide carousel with up to 54,000 slides (that will never be in upside-down or backwards). These still frames can be accessed in a matter of seconds with either the remote control unit or a computer, and most of the discs provide a written log with the frame numbers.

Simulations are another powerful application for IVD. An example might be an emergency room diagnostic trainer for a heart attack victim. If the intern does the right things, the patient stabilizes. If the intern makes a "fatal" mistake, the student can "see" the result.

Configuration for IVD

IVD can be delivered with either an IBM or compatible, Apple II, or Macintosh computer. As with the other optical media, you will need a special player for the videodisc (see Figure 1). You also need a video monitor because the output from the videodisc player will not display on a computer monitor.

Advantages of IVD

Access—Frames and segments on a videodisc are accessed by using a remote control unit, barcode reader or computer. The access is fast and precise.

Quality—Videodiscs are generally recorded with 350 lines of resolution. VHS and Beta videotapes are recorded with only 200-250 lines of resolution.Therefore, videodiscs have a sharper appearance and better quality picture.

Still Frame—Videodiscs can be paused on a still frame for hours with no damage. This provides individual access to every frame on the disc.

Dual Audio Track—Two audio tracks are available on all videodiscs—allowing either stereo sound or two separate narrations.

Disadvantages of IVD

Lack of interface and software standards—Connecting a computer to a videodisc player can be very frustrating. Different players require different cables, baud rates, and software.

Read Only—Videodiscs are "read only" which means that you cannot record on the disc. This is a disadvantage in that you cannot record or copy student productions, etc.

Cost of Hardware and Software—Although prices are declining, it is still difficult for a school to be able to afford more than one or two workstations with interactive video.

Compact Disc Read Only Memory (CD-ROM)

CD-ROM was introduced in 1985 and stores digital text, graphics, and sound on a small compact disc (4.72 inches in diameter). CD-ROM provides a low-cost method for storing an enormous amount of data (up to 650 megabytes). This is equivalent to over 1,500 floppy diskettes (360K) or an 20-volume print encyclopedia

CD-ROM Applications

Educational applications for CD-ROM fall into three main categories. The most popular application for CD-ROM in K-12 education is the ability to store an entire encyclopedia on a compact disc - and provide keyword searching capabilities at the same time. *Grolier's*, *World Book*, and *Compton's* all have CD-ROM versions on the market, and in most cases they are less expensive than the text versions.

Another popular application for CD-ROM is the storage of databases, such as ERIC and Magazine Index. These databases provide quick, easy access to bibliographic information, abstracts, and, in some cases, complete text.

The third category of applications is the distribution of public domain software Programs such as *PC-SIG* (Personal Computer-Special Interest Group) contain thousands of computer programs that can be copied and used for a minimal fee.

Configuration for CD-ROM

CD-ROM drives can connect to IBM or compatibles, Macintosh, or Apple II computers; however, the software must be compatible with the computer. The computer monitor is used to display the data and an input device (usually a keyboard) is required to enter queries (see Figure 2). Most CD-ROM drives can also play audio compact discs.

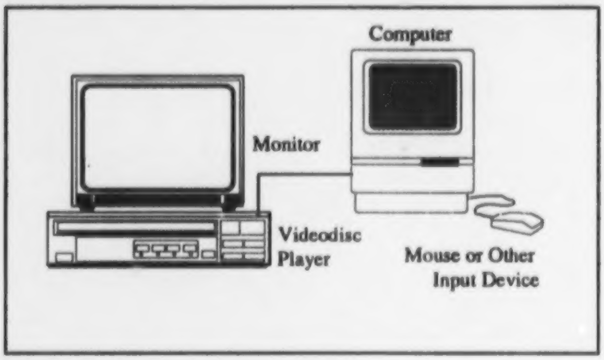

Figure 1. Configuration for IVD

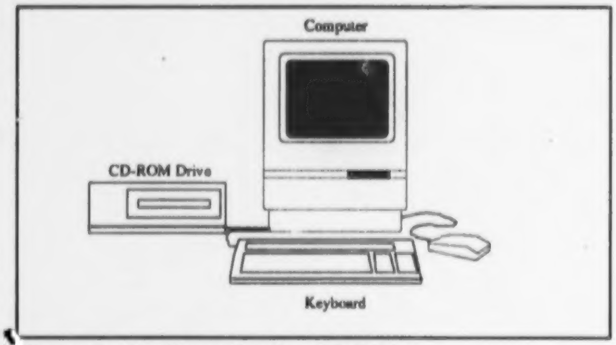

Figure 2. Configuration for CD-ROM

Advantages of CD-ROM

Large Storage Capacity. CD-ROMs can store over 650 megabytes of data.

Fast Searching Ability. CD-ROMs can search through enormous amounts of textual information in a matter of seconds, yielding precise results.

Many Applications Available. Thousands of titles are now commercially available.

Disadvantages of CD-ROM

Read Only—The information on the disc cannot be updated or changed.

Subscription Rates May be High—Similar to magazines, some CD-ROMs require a subscription fee, which may adversely impact a school budget.

Speed—Although searching on a CD-ROM is much faster than manual searching, CD-ROMs are slow in comparison to hard drives.

Compact Disc Interactive (CD-I)

Compact Disc Interactive (CD-I) is taking a different approach to optical media. Again using a disc which is approximately 5 inches in diameter, the producers of CD-I have developed a player with a built-in computer processor. The end result is a single unit that can connect directly to a home television or monitor. CD-I players look a lot like audio CD players, and they can play audio CDs. They also offer graphics, sound, text, animation, and interactivity. Users interact with the unit via a joystick or remote control unit. Even the price is attractive to the consumer market (less than $1000). CD-I discs also store video, but they can currently only produce one-quarter screen if full motion is used.

CD-I Applications

Commercial products for CD-I focus on entertainment, education and reference materials Most of the applications are highly entertaining and designed for use by one or more family members sitting a considerable distance from the home television set.

Using *Children's Musical Theater*, children can create and customize songs, watch creations which are performed by an animated band of musical animals, and even take over for one of the musicians or vocalists. *Children's Musical Theater* includes a Cajun alligator recording engineer, a bass-playing dinosaur, a clarinet-nosed alien, and lots of other "recording artists" to help customize one of four songs that comes with the program.

The *Treasures of the Smithsonian* program provides students access to hundreds of the most popular Smithsonian Institution exhibits. Each is presented through photographs, a narrative with musical accompaniment, textual information, and graphics. The student also has the opportunity to hear sounds associated with a museum artifact or to manipulate a graphic representation of it. For example, you can actually "play" notes on a hammer dulcimer or try to produce Morse code on a 19th-century telegraph key.

Configuration for CD-I

CD-I systems are self-contained and connect easily to a home television set. The discs are standard 4.72 compact discs, and the remote control unit is a combination mouse/joystick (see Figure 3).

Advantages of CD-I

Cost—The consumer model of CD-I costs less than $1000.00. Most applications average between $20.00 and $50.00.

Ease of Use—It is very easy to connect a CD-I player. Simply attach the audio and video from the CD-I player to a TV monitor, just like you connect a VCR.

Standardization—CD-I has set a worldwide standard for players and discs. That means that any CD-I disc will play on any CD-I player.

Disadvantages of CD-I

Limited Motion—At present, very little motion video is being utilized in CD-I programs. The capabilities of CD-I include a maximum of 1/4 screen motion video at a reduced frame rate.

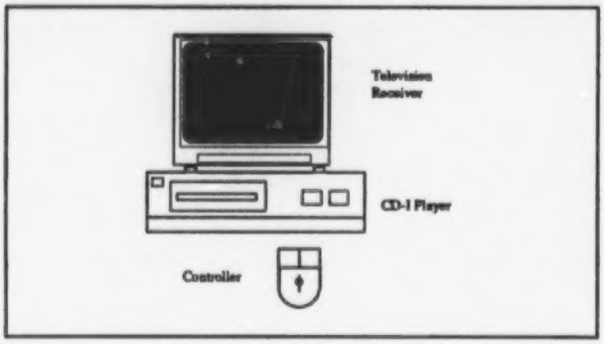

Figure 3. Configuration for CD-I

Lack of Titles—This technology is very new. Although many titles are promised, few Figure 3. Configuration for CD-I currently exist—especially for education.

Commodore Dynamic Total Vision (CDTV)

Commodore Dynamic Total Vision (CDTV) is a system very similar to CD-I. This system uses the technology of Commodore Amiga computers to create a multimedia player that will output to a television set. CDTV incorporates a CD-ROM player with proprietary graphics and audio processors. The user interacts with the system through a 10-key infrared remote control unit or infrared mouse. A "card" port is also included to save data from games, enabling the user to resume the game later.

CDTV Applications

CDTV systems were introduced in 1991, at a cost of $995.00. Many titles are currently available, including games and reference programs, such as *Grolier's Encyclopedia* and a multimedia version of the *Rand McNally Atlas*. Educational programs for reading and math are also being produced.

World Vista Atlas offers a wonderful multimedia exploration of the earth and its people. In addition to maps, it features text, graphic images (flags, for example), more than 1000 high-resolution photos from 135 countries, ethnic music from the Smithsonian Folkways Collection, and spoken examples of 61 foreign languages. The many maps include large-scale outline or "locator" maps that allow you to point and click to get where you want to go and detailed country maps supplied by Rand McNally. Details are recognizable because the program zooms in on the entire map and lets you scroll across it, viewing a section as small as 30 miles across.

Configuration for CDTV

CDTV players can easily connect to a television receiver or monitor. The players have built-in Amiga computers, and interfaces are available to attach disk drives, keyboards, printers, etc.—enabling you to run Amiga software. The remote control unit is a combination of arrow keys, numeric keypad, and control keys (see Figure 4).

Advantages of CDTV

Cost—The cost of the unit is slightly less than $1000.00. Most of the programs are in the range of $20.00 - $50.00.

Ease of Use—It is very easy to connect a CDTV player. Simply attach the audio and video from the CDTV player to a TV monitor.

Connectivity—It is possible to connect a wide variety of peripherals to a CDTV player, including a keyboard, modem, joystick, etc.

Commodore Expertise—Commodore has a great deal of experience and expertise creating computer graphics and animation. The same techniques are being used to create CDTV programs.

Disadvantages of CDTV

Limited Motion—At present, very little motion video is being utilized in CDTV programs.

Lack of Titles—This technology is very new. Although many titles are promised,
few currently exist—especially for education.

Digital Video Interactive (DVI)

DVI is a technique invented to compress video, which can then be stored on a compact disc. A special computer board is used to decompress the video on a microcomputer when it is played back. This method allows 72 minutes of full motion/full screen video to be stored on a small CD. That's a tremendous amount compared to 30 minutes on a 12 inch videodisc and it's all digital which means the computer can control it. This technology can also store various levels of sound and graphics.

DVI Applications

Because of its ability to integrate media, DVI has great potential in education and training. One example is *Palenque*, an educational discovery pilot developed by Bank Street College of Education, New York. This application allows the user to explore various aspects of an ancient Mayan site. A multimedia database accompanies the traveler through the site, providing movies, audio, still pictures, and text about the rainforest, the Mayans, and ancient writing. Although there are few commercial DVI applications currently available, as the costs decrease, DVI's applications in education and training are likely to increase.

Configuration for DVI

DVI requires an IBM/AT compatible computer with a special board set and a computer monitor. Because of the large size of the files (even after they are compressed), a CD-ROM is generally used to store the files (see Figure 3).

Advantages of DVI

72 Minutes of Motion Video—The capacity of DVI, if stored on a CD-ROM disc, is 72 minutes with full motion. If partial-screen motion is used, even more video can be stored.

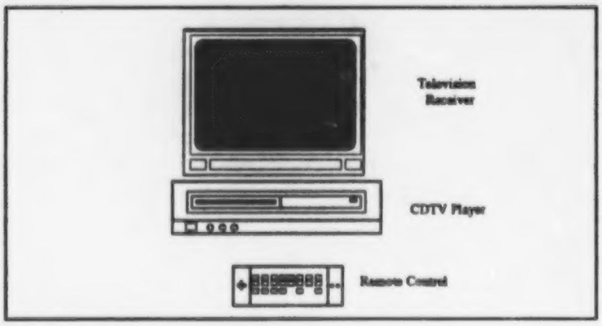

Figure 4. Configuration for CDTV

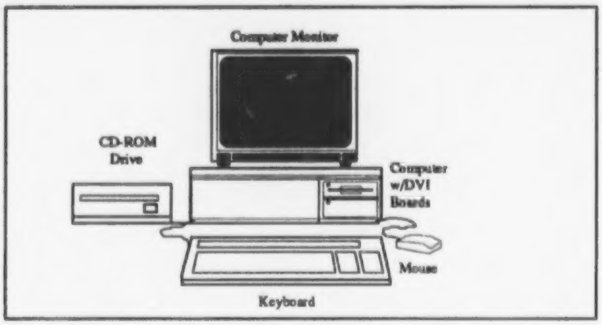

Figure 5. Configuration for DVI

Full Screen Video—DVI is currently the only digital technology that can display full-screen, full-motion video.

Generic Equipment—At this time, any IBM/AT compatible computer is capable of being converted into a DVI workstation by adding the two computer boards. Current plans are to transfer the technology to Macintosh computers.

Disadvantages of DVI

Cost—The computer boards that are required currently cost about $2500.00. If you add that expense to the cost of an IBM/AT computer, it gets quite expensive. Complete workstations are now being sold for about $7500.00.

Complexity—Creating DVI applications is extremely complex. Although authoring systems are beginning to appear on the market, most DVI applications are written in a high-level programming language.

QuickTime

Apple Computer company released QuickTime in early 1992. QuickTime is similar to DVI in that it is not necessarily an optical technology; however, because of the large file sizes, many of the applications will be stored on CD-ROM discs.

QuickTime is a new file format that allows Macintosh computers to compress and play digitized video movies. QuickTime works without any additional hardware (although a digitizing board is required to capture the video). The video is automatically compressed when it is recorded and decompressed when it is played back. The movies can be cut and pasted or imported into a variety of Macintosh applications, such as HyperCard, word processors, and presentation programs.

QuickTime movies currently play in a 2X2 inch window on the Macintosh monitor at about 15 frames per second (half the normal rate). Although the size can be expanded, the speed of the movies decreases substantially. The average current storage requirement is 10 megabytes for each minute of QuickTime movie.

QuickTime Applications

QuickTime movies will enhance many existing educational applications and lead to the development of several new ones. For example, *Compton's Multimedia Encyclopedia* on the Macintosh now incorporates QuickTime movies and several interactive programs, such as *Animated Dissection of Anatomy for Medicine*, include movie segments.

QuickTime is also having an impact on low-cost video editing. With the use of relatively inexpensive capture boards and software, video clips can now be edited and stored directly on the hard drive of a computer for playback at another time. Many clip libraries are also available for editing and incorporating into final productions.

Configuration for QuickTime

The QuickTime file format operates on any color-compatible Macintosh with at least 2 megabytes of RAM and system 6.07 or above. The only requirement for delivery of video clips is a file (called QuickTime startup document) in the system folder. This QuickTime file is released free-of-charge by Apple computer.

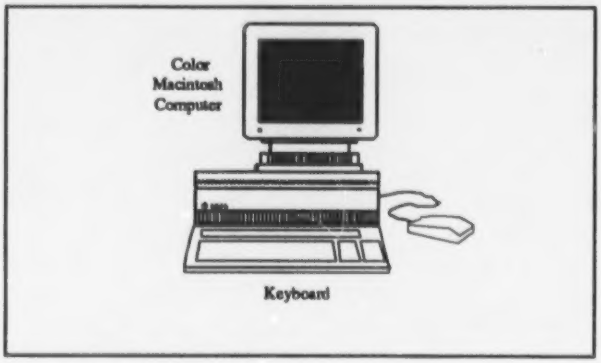

Figure 6. Configuration for QuickTime

Advantages of QuickTime

Free—The file needed to run a QuickTime movie is distributed free-of-charge by Apple Computer. It must be placed in the system folder.

Does not require delivery hardware—The best feature of QuickTime (as opposed to DVI) is that no additional hardware is necessary for delivery.

Synchronizes video and audio—When QuickTime movies are recorded, both the audio and video are recorded together and remain in synchronization.

Extends Macintosh interface for video—Because QuickTime is a recognized file format for Macintosh, the movies can be cut and pasted between applications as easily as graphics and text.

Disadvantages of QuickTime

Small pictures—QuickTime currently supports movies in a small, 2 X 2 inch window. As the technology matures, this size is sure to increase.

Requires large RAM—At least 2 megabytes of RAM is required for QuickTime, and 4 to 8 megabytes are recommended.

Requires large storage—Even though the video is compressed when it is stored, the file size is still enormous. Even a high-density diskette can only hold a few seconds of QuickTime movies; therefore, most of the movies will be distributed on CD-ROM or cartridges.

Less than 30 frames-per-second—Most QuickTime movies display at about 15 frames per second. This results in a slightly choppy appearance.

Conclusion

Optical technologies and digital formats offer great potential to add new dimensions to education and training. CD-ROM and IVD are already impacting the educational process in most schools, and more powerful technologies, such as DVI, CD-I, CDTV, and QuickTime are on the horizon. The integration of these technologies offers opportunities, as well as challenges, to teachers, students, and administrators.

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Paper (M3-06)
Videodisc for Visual People: Teaching Interactive Video to Hearing Impaired Students

Gerald Pollard
Texas School for the Deaf
Austin, Texas

Abstract

If ever there was a natural marriage of media and a special population, it is with videodisc and visual people. Videodiscs make available to the classroom some of the most powerful visuals recorded. Their ease of use allows for great flexibility in the way they can be applied in the classroom.

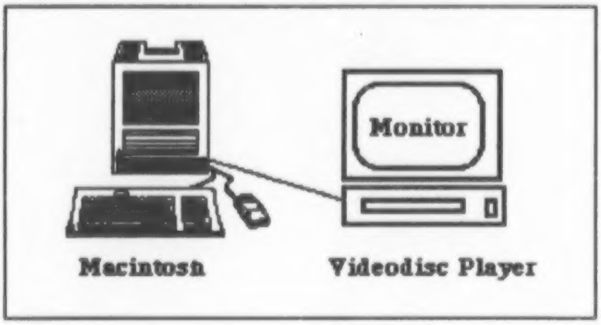
If you are born profoundly deaf, your world becomes a visual one. Most of what you learn comes through your vision. Visual people need the best visual stimuli affordable today.

The combination of videodisc and a computer is another powerful marriage. The computer can provide the best of computer assisted instruction while the videodisc can provide rich colorful graphics, still frame or motion sequences, forward or reverse viewing at a normal, fast or slow rate of speed.

When visual people can learn from an interactive video you have the most powerful learning environment affordable today. This presentation will address the interactive video instruction provided at the Texas School for the Deaf, the service provided by students to other staff and describe and demonstrate some of the software developed by students.

Instructional Courses

Presently two interactive video classes are provided for high school students. The basic course, a one semester course, teaches students the fundamentals of operating a Macintosh computer, becoming skilled in using HyperCard[1] graphics, acquiring skills in writing HyperCard stacks and creating computer-based instructional units using HyperCard and interactive video. The advanced class, a two semester class, builds on the basic class and enhances students skills by creating a variety of interactive video instructional units. In this class a student will interview a subject matter expert (a teacher) to determine what the interactive video lesson(s) should look like. Together they determine what visual sequences will occur, what questions will follow and what appropriate feedback should be provided. Students then plan on paper, code and debug their program until its completion.



Software Developed

One student in the basic interactive video class was enthralled with the vivid graphics on the Visual Almanac[2] videodisc. He was also interested in and taking a photography class. This student produced an interactive video lesson that teaches the user how to determine slow motion photograph from time-lapse photography. The title frame provided the name of the unit and its author. The next frame asked for the user's name and welcomed the user to this program. The next frame provided a video button which showed an example of slow motion photography. The following frame explained how slow motion photography worked. The next frame provided three different illustrations of slow motion photography. Next, time-lapse photography was introduced with a visual sequence of a building being razed by dynamite. Then a definition of time-lapse photography was provided followed by three different examples. Following these two introductions, the user is provided an option of "Review" or "Test". The review recycles through the same material; the test consists of a video button, which presents either a time-lapse or slow motion example followed by a multiple choice question. Praise is provided for the correct answer and feedback is provided for an incorrect response. Both students and staff who participate in this unit are amazed at the learning power of this environment. They frequently want to experience the unit again and again.

In our teacher's lounge last spring, I overheard Ann Duke Shaw, one of our best reading teachers, say "I wished I had a good baseball story for my kids. That would sure hold their interest since most of the class are boys." With that statement I wasted no time in opening up the idea of interactive video with the movie, Field of Dreams. The teacher was not sure what interactive video was but was willing to "run with" the idea. Our school purchased the videodisc for $30.00 locally which came with closed captions for the hearing impaired. This entertainment disc is a constant linear velocity (CLV) format and searches are based on a time code rather than a frame number. Not having the ability to use still frames or playing the videodisc backward or not being frame accurate are limitations of the CLV formate on a Pioneer 2200 videodisc player. None of these limitations bothered us.

We previewed the movie together and made our own notes regarding time frame numbers (minutes and seconds) and the content of the movie. The reading teacher drafted the questions she wanted from each movie segment which emphasized reading for detail and gave them to one of my advanced students. Twenty-five questions were coded into the computer, all with a video segment to watch, questions to answer and appropriate feedback provided. In the mean time her class was reading the book *Shoeless Joe* by W. P. Kinsella which served as the basis for the movie. Then they watched the movie in its entirety. My student presented the interactive video unit "Field of Dreams" to the reading class and they could not get enough of the unit. They wanted to see the program again and again. At first they would see a video segment, then make a group decision as to the appropriate answer. Later, they wanted to operate the program by themselves.

This unit was highly successful for the reading teacher and her students because of the level of motivation and thus learning was extremely high. My student, who had demonstrated his interactive video skills, received praise and recognition from his peers and other staff members and provided a service for others as well. It has opened the door for other interactive video units across our curriculum.

References

HyperCard is produced by Claris Corporation, 5201 Patrick Henry Drive Box 58168, Santa Clara, CA 95052-8168

Visual Almanac Videodisc, produced by Apple Computer and disseminated by Optical Data Corporation,30 Technology Dr., P.O. Box 4919, Warren, NJ 07059 ($100.00).

Kinsella, W. P. (1982). *Shoeless Joe*, Ballentine Books, New York

Special Presentation-ISTE (M3-07)

Integrating Technology into Teacher Education Programs: What's Happening?

Charlotte Scherer, Moderator
Bowling Green University
Bowling Green, Ohio

Abstract

This session will be a panel presentation by five people working in Colleges or Schools of Education with faculty and students to integrate technology into the teacher education programs. Presenters will describe what is happening at their institutions and how they are educating faculty as well as students in the uses of technology for instructional purposes at all levels. Each presenter has had experience at an institution where technology has been supported in a variety of ways, and each has helped to begin the process of integrating the technology into the teacher education programs for pre-service and in-service teachers. Descriptions of the methods used to assist non technology using faculty to get started as well as ways faculty are beginning to use the technology for their own purposes and for instruction will be described. Participants will also discuss the issue of providing a core technology course versus the incorporation of technology components into professional education courses. Following the formal presentations there will be a question and answer time for the audience.

Projects (M3-08)
Social Studies K–12

World Classroom: Social Studies for a Global Society

Robert Summerville, Christine Drew
Pinson, Alabama

Abstract

Abstract not available at press time

Where in Sand Springs?

Franki Hooper, June Ehinger
Sand Springs Public Schools
Sand Springs, Oklahoma

Abstract

Following the tradition of Carmen San Diego, students are provided with a mystery and clues that lead them to various places in Sand Springs. The purpose is to acquaint them with their home town and how a city operates by visiting places like the library, Chamber of Commerce, airport, fire station, police station and court house. Students developed a folder using Linkway as a culmination of the project. It included pictures and descriptions of the places they visited. This presentation will include excerpts from the Linkway project and model lesson plans which could be adapted for any classroom.

The Alabama History Database Project

Robert Summerville, Christine Drew
Pinson, Alabama

Abstract

Abstract not available at press time

Our Town: Putting Community, Schools, and Multimedia Together

Nancy Baumann, Kaye Coats, and Janice Gold
Tulsa, Oklahoma

Abstract

Getting the community involved in the use of technology in schools provided support for funding of future technology projects. The opportunity for adults and students to collaborate encourages participation of citizens in the schools and students' in the city. Students visited the community; community members visited the schools, where the were interviewed on video tape. Students researched ideas and background provided by the interviews, and prepared a multi-media computer presentation using IBM's Linkway. *Our Town* was divided into subject areas such as city government, schools, history, parks and recreation, civic organizations, industry and economics. *Our Town* became a cooperative effort of the school, students, community organizations, community leaders and volunteers.

Special Presentation–EDUCOM (M3-09)
Turning the Internet into a K-12 Resource

Jim Luckett, Chair
Executive Director, NYSERNet, Inc.
Syracuse, New York

Abstract

Three viewpoints: (1) finding things on the Internet (NYSERNet book, SUNY "Beyond the Walls" videotape, UC Davis "Mining the Internet" presentation, MERIT directories project, FARNET update on K-12 resource survey); (2) storing, finding and retrieving K-12 materials on the Internet: presentation by someone from WAIS Support Center, North Carolina; (3) creating curriculum-based collaborations using the Internet: presentation by a teacher/curriculum specialist.

Projects (M3-10)
Distance Learning–Media Centers

Reaching Out: Distance Learning in the Classroom
Diana Radspinner
Fort Worth, Texas

Abstract

Abstract not available at press time

Making a Center for Media the Center for Instruction
Hope Erickson
Eanes Independent School District
Austin, Texas

Abstract

Media centers are facing a major challenge as new technology enters our schools. Not only must they keep current with the equipment, but new processes must be established for training the students and teachers to appropriately make use of the resources.

Schools in Eanes ISD are redesigning their library space to reflect the instructional needs of each campus. Incorporated into the media centers are various kinds of technology that used in the different departments of the school. This means that Macintoshes, DOS machines and Apples are all available for student use. Students are able to conduct research and sit right down at computers and write rough drafts. Videodisc players and CD ROM players provide enhanced research capabilities. A completely automated library services package that runs on the district IBM AS400 computer network facilitates purchasing, inventory and check-out procedures as well as an electronic card catalog for patron use. On-line search capabilities allow students and teachers use to Dialog, Prodigy and Tenet—a state of Texas communication system that, among other things, provides access to several different university card catalogues. A satellite downlink at the high school allows students the opportunity to study Japanese and teachers to participate in staff development.

Media specialists work with both teachers and students on a regular basis to help everyone on the campus understand how this support base of technology can help them as they do research and study in the various areas of the curriculum. Eanes was pleased to have the West Ridge Middle School be chosen as the exemplary middle school library in Texas.

Panelists will share the planning and implementation process at both the district and campus levels, equipment that was used, the problems encountered and the training process used with students and teachers.

The McCullough TEC•Lab: Bringing Technology to All Disciplines
Larry McHaney
The Woodlands, Texas

Abstract

The McCullough High School Technology Educational Curriculum Laboratory (TEC•Lab) is an exciting multi-curricular project involving science, mathematics, language arts, social studies and technology classes. Funded by the Texas Education Agency's Innovative Education Grant Program, the TEC•Lab is studying the effects of a technology rich environment on the achievement and attitudes of middle to lower achieving students. Three levels of technology exposure are being compared: Immersion (everyday in the TEC•Lab), Infusion (once a week in the TEC•Lab) and Comparison (no exposure to the TEC•Lab, only what is normally available to classes within the school).

Equipped with a vast array of the latest technologies, from computers and scanners to computer numeric control equipment, robotics, video editing equipment, CD-ROM, Laser disc, modems and fax machine, the TEC•Lab offers a unique opportunity for students and teachers to bring the world into the classroom. Together they can apply the curriculum through real problems and using real tools they develop real solutions. Each teacher will share what they have learned from the experience and preliminary results of the research study.

Projects (M3-11)
Business and Vocational

From Nothing To Everything in Educational Technology: Business/Industry Partnerships

S.W. Hollingsworth
Northwest Independent School District
Justin, Texas

Abstract

This project describes the growth of a small North Texas town into an enviable technological education center. Its development is tracked through the district realization that it must meet the demands of the 21st century and recognition of the necessity to combine educational efforts with the needs of business and industry. Emphasis is placed on the value of including the private sector in the planning, development, and review of technological efforts to deliver pedagogy—not on seeking financial support. The result has been the development of a symbiotic relationship between education and business that ensures quality education for students.

Highlighted are some of the major companies and individuals that have made commitments to donate time and expertise to the Northwest Independent School District. This project can be a model for other districts that want to tap the knowledge and expertise of businesses within their field of influence.

Have You Visited the Real World Yet!

Trudy Holder
Port Neches-Groves High School
Port Neches, Texas

Abstract

Students in the Office Education program at Port Neches-Groves High School are participating in a new exciting restructured program to encourage them to solve problems; communicate with other students, adults, and business and industry leaders; to think innovatively, critically and analytically; and to become lifelong learners as a part of a sophisticated and well-educated workforce.

The project challenges the student to understand economic development and environmental concerns as they relate to the community, the school, the people, and also provide the students with a real-world interactive learning experience. Each cooperative learning group collects data, creates databases of information and analyzes data stored about the elements they choose to study in the community. Each group has a business or industry mentor who will constantly evaluate the effectiveness of the projects and offer suggestions for any change in direction. This is an online development of curriculum. The students participate in an electronic community of learners using TENET (Texas Education Network) in disseminating information about their community.

Integrating Academics and Cooperative Learning into Computer Applications Courses

John Steffee
Tyler, Texas

Abstract

There is a need to change the focus of the computer applications classroom. It is not good enough any more just to teach word processing, spreadsheet and database skills in the applications classroom. These software packages should be used to teach math, social studies, science and language skills.

Instead of typing meaningless passages on the word processor, teachers need to use lessons and materials that strengthen reading, writing, and writing composition skills. Instead of manipulating numbers at the end of the chapter when learning spreadsheet skills, students should be learning basic math skills. Science, language arts, and social studies skills can be taught at the same time students are learning database skills.

Our students also lack interpersonal skills. The computer classroom is well-suited to cooperative learning. Students could work together in teams which would reinforce both learning and interpersonal skills.

For our students to be successful, all teachers must focus on a common goal. We can no longer teach as if our subject matter is the only one in the curriculum. There is no place more practical for this integration to occur than in the vocational computer classroom.

Special Presentation–ISTE (M3-12)
Hypermedia and Multimedia in Education

Abstract

In this session, authors will individually discuss research projects around the theme of Hypermedia and Multimedia in education with which they are presently involved. Each participant will have approximately 10-12 minutes to discuss salient aspects of the project/research , followed by questions from the audience. Each of these were chosen based upon hyper/multimedia use and offer both practical and innovative uses of this technology in an educational setting.

Authors/Titles:

Developing Cultural Literacy Using Interactive Videodisc Programs
Barbara Boyer
California State University, Los Angeles
Los Angeles, California

Don't Forget Design: Developing Effective & Appealing Hypermedia Materials
Annette Lamb
University of Ohio
Toledo, Ohio

Children's Comprehension of Interactive HyperCard Narratives
Hillary McLellan
Kansas State University
Manhattan, Kansas

A Comparison of Four Authoring Tools for the Development of Hypermedia in Education
Penny Semrau
California State University, Los Angeles
Los Angeles, California

Projects (M3-13)
Restructured Schools

The Role of Technology in a Restructured School

Gwen Solomon, The School of the Future
New York, New York

Abstract

Does technology make a difference? At New York City's The School of the Future, it does. We focus on technology as it supports our goals for a restructured learning environment and find that technology makes students more productive, excited about learning, and challenged intellectually. Technology not only helps them do things better and faster but also provides ways to do things differently and to do different things. While it sounds like the perfect tool, we take a hard look at how it helps students learn.

Our philosophy is that all students can learn and that all students will learn to use their minds well, so we try to do things that will promote the philosophy. We ask ourselves, "What do we want to accomplish? What's important for students to know and be able to do? How do we get them there? What tools work best?"

Basically, we need methods and tools that enable students to think, ask good questions, solve problems, make decisions, and communicate. Because technology is so effective, we use it in many classes. While there are no absolute answers on how technology should be used, we believe we're on the right track. Join us in a discussion of how we promote better learning through technology.

"Looking Through the Windows of the World" Starts by Opening Shutters at Home...

Kam Matray, Gerry Montgomery
California Model Technology Schools Project
Monterey, California

Abstract

"Looking Through the Windows of the World" starts by opening shutters at home...

The California Educational Technology Committee established the California Model Technology Schools Project in 1987 to research and demonstrate the effective use of technology in K-12 instruction. The project funds six districts throughout California at $500,000 per year over a five-year period. Each of the project sites has developed its own unique approach for planning, implementing, and evaluating the use of educational technology. Join the co-directors of the Monterey site for a project update that takes attendees through Year V activities of this "ultimate field trip". This update includes overviews of the research design, staff development model, dissemination, research and evaluation findings, as well as a look at teacher-authored products.

Monterey, California opened the shutters at home, so now....

The Future Is Now in Romulus, Michigan

William Bedell
Romulus Community Schools
Romulus, Michigan

Abstract

The district has begun creating a totally new school environment, which puts the full power of today's technology at the fingertips of both teachers and students. In Romulus, the classroom of tomorrow is already in place. Sophisticated networks deliver state-of-the-art video and computer instructional tools to both individual classrooms and 35 station-Computer Assisted Instruction Classrooms (CAIC's) located throughout the school.

Key Components of this 21st Century learning environment include:

- A school-wide Integrated Information System, which gives every classroom teacher keypad access from the classroom to the school media center and all it's laser disc, CD ROM and VCR video technology.
- Instructional software from Jostens Learning Corporation, and hardware from Apple Computer, Inc. networked into classrooms and CAIC's.
- Jostens Learning Corporation and Apple Computer, Inc. commitment to the total instructional program of the Romulus School District—Comprehensive on site daily consultant assistance.
- 33" colored T.V. monitors for computer and video display in every classroom and CAIC room.
- Telephones in each classroom for two way communication.
- Satellite dish for distance learning.
- Extensive staff development and training, so that teachers learn how to integrate instructional technology into their teaching lessons.
- Improving the way teachers teach and students learn.

In the Romulus Community Schools, every student truly does have the opportunity to learn and succeed. Teachers are equipped with technology that delivers both individualized and collaborative instruction to the shared CAIC's, as well as into each classroom. Teachers also receive the training they need to make the most of their instructional tools, and become true facilitator of the learning process.

Romulus Community Schools Superintendent William M. Bedell is convinced that all students can learn when quality instruction is delivered to every student and when local school districts are funded properly. The goal in Romulus is to use instructional technology to help every elementary student enter middle school at grade level, ready to meet the demands of the 21st century. This goal will be continued through the middle school and high school when Phase II of the Romulus School Districts restructuring plan is completed in September, 1993. Says Dr. Bedell: "We are ready to meet the challenge of helping all our students meet their potential."

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Special Presentation (M4-01)

"HyperWhat?" Turning Technology to Your Own Devious Purposes

Roger Wagner
Roger Wagner Publishing
El Cajon, California

Abstract

Hypermedia is a term that is almost impossible to escape these days. In fact, the deluge of references to the term could easily numb anyone into indifference.

This session takes a fresh look at the day-to-day problems facing every classroom teacher, and how hypermedia offers a wide range of solutions, as a personal tool that can improve not only their teaching effectiveness, and but which can help address some inescapable "political" issues as well.

Things begin with a look at three general problem areas confronting the teacher:

1. Competing with Nintendo & Sesame Street
2. Moving Goal Posts: Changing Teaching Requirements & Resources
3. PR: An Inescapable Reality

"Competing with Nintendo & Sesame Street" looks into just what the teacher is really competing with. TV by its nature can supply information to individuals with different learning styles. A look at Sesame Street reveals the use of information modes for visual and auditory learners, as well as the usual written word-oriented approach. In addition, TV just seems more "real" to today's children than the typical classroom experience.

Teachers can be frustrated by demands that they change the order and content of classroom material they've prepared, often with years of cumulative work. When these demands are repeated every few years with new laws and administrators there to make their own mark, it can seem overwhelming. With shrinking budgets, and growing requirements, the tools to try to achieve these goals become increasingly limited.

Lastly, whether teachers like it or not, they are all in the "PR business". A moment's thought will reveal that the sports department seldom has trouble getting new funds for equipment, travel and even land and stadiums, while the computer department may be struggling just to acquire more blank disks.

At this point, a quick overview of just what hypermedia is, and a sample of a typical student project will be shown ("History of Space"—6th grade), and the result recorded on a videotape. A standard classroom monitor and VCR are shown as the display and recording equipment. This is a more "real world" example than the expensive equipment often shown at other conferences.

Along the way, we'll see how hypermedia projects provide a rich environment for learners of all styles, and can also be a powerful teacher tool as well. Student ownership of the project, and their creative link to the "real world" of TV and video is a powerful motivator, and expresssive environment. Finally, the end product of a videotape can be an impressive, yet inexpensive way to share what is happening in the computer-using classroom with parents, community, and administrators.

The session concludes with re-examining each of the three problem areas discussed at the beginning, and discovering how using hypermedia as your own "secret weapon" provides easy and direct solutions to these problems. Hypermedia is more than a glorified slide show, or talking encyclopedia. The real potential of hypermedia is as a creative and expressive tool for the student as well as the teacher. Teachers will find it well worth their while to learn how to use and implement hypermedia, not just for the higher goals of education, but as a very practical and time-saving solution to problems they must deal with on a daily basis. In addition, the use of equipment they already have will be stressed, so that everyone attending can find out how to use existing equipment, without having to worry about additional burdens on their shrinking budgets.

A hand-out titled "The VCR as a Printer" will be available.

Special Window (M4-02)
Artificial Intelligence in Education

Greg Kearsley, Moderator
The George Washington University
Washington, D.C.

Abstract

This panel will present an overview of an artificial intelligence based fundamental skills training system (FSTS) project's first year of development and implementation. This will be done through a discussion of initial and on-going development, classroom application through a content/skill area—Pre Algebra Problem Solving through Word Problems, a review of its impact in a public school locale, a quantitative and qualitative evaluation of student and teacher interactions and the mechanisms by which government, higher education, and a local school system were able to pool their expertise in this cooperative venture. In addition a discussion of recent developments in artificial intelligence and their import to the educational community will also be presented.

Panelists:

Richard Diem
The University of Texas at San Antonio
San Antonio, Texas

Juanita Firestone
The University of Texas at San Antonio
San Antonio, Texas

Kenneth Wunderlich,
The University of Texas at San Antonio
San Antonio, Texas

Linda Hunter
MacArthur High School
San Antonio, Texas

Kurt Steuck
Brooks AFB
San Antonio, Texas

ADAPT Spotlight (M4-03)

Tools, Techniques, Ideas, and Advice for Students and Adults with Learning Differences

Richard Wanderman
Consultant
Litchfield, Connecticut

Abstract

Tools like computers, dictating tape recorders, label printers, pocket calendars, answering machines, and even the lowly highlighter pen, can make a big difference in the lives of people with language and learning differences. During this session, we will examine and discuss how various tools and ways of using them can help people compensate and in so doing, participate in the world of paper, appointments, phone conversations, meetings, and more.

Special Presentation–Panel (M4-04)

Education on the NREN: Organizing Internetwork Educational Activities

Jim Levin, Moderator
University of Illinois
Champaign, Illinois

Abstract

The new gateways between different educational electronic networks are major steps toward a national education network. These gateways raise important issues about how educational activities can be organized effectively when these activities are conducted on several different interconnected networks. This session will serve as a forum to discuss these issues. Members of the panel are key players in grassroots K-12 networks (FrEdMail), commercial educational networks (AT&T Learning Network), state-wide educational networks (TENET), university-based educational networks (Internet), and backbone networks (NSFNet). The panel members have "practiced what they preach," and have conducted their discussions on this topic over these several interconnected networks, involving graduate students as "teleapprentices" in their work. The results of this "tele-task force" will be reported during this Special Session.

Panelist:

Al Rogers
FrEdMail Foundation
San Diego, California

Beverly Hunter
National Science Foundation
Washington, D.C.

Connie Stout
Texas Education Agency
Austin, Texas

Margaret Riel
AT&T Learning Network
San Diego, California

Michael Waugh
University of Illinois
Champaign, Illinois

Special Presentation–CCSC (M4-05)

Impact of ACM/IEEE and DPMA Curricular Reports on Small Colleges Consortium for Computing in Small Colleges

Barbara Boucher Owens
St. Edward's University
Austin, Texas

Bill Myers
Belmont Abbey College
Belmont, North Carolina

Waldo Roth
Taylor University
Upland, Indiana

Abstract

This presentation will be divided into several parts. Each of the two curricular reports, *The ACM/IEEE Task Force Report* and *Information Systems—The DPMA Model Curriculum for a Four Year Undergraduate Degree*, will be summarized. Each of the presenters will describe how programs in place at their home institutions measure up to the new standards. One of these programs is a CS program with a Software Engineering focus, one is entirely information systems, and the third is a program which uses the same core courses to offer both computer science and information systems degrees. The ACM/IEEE Task force report will require some creativity on the part of many small colleges to be integrated into their programs. The DPMA Model will be useful to small colleges with Information Systems curricula. Some real concerns seem to be surfacing for those schools whose CS and IS programs share a common core. Ample time will be available for discussion and audience input.

Paper (M4-06)

Keeping Your Computer Virus Free: Security and Control Recommendations

Albert J. Marcella Jr.
Millikin University
Decatur, IL

Abstract

For most people, a computer virus sounds like something out of a science fiction novel. But recent events, in many diverse locations have demonstrated that computer viruses are very real and pose a very real threat to organizations dependent upon computer generated information. Computer viruses have received a lot of attention in the press recently, and motion pictures are even using computer viruses as central themes. However, the "viruses" which have invaded computers around the globe have not all been "true" viruses, but instead self-reproducing programs (SRP), a broader classification of malicious code which includes worms, time bombs, holes, moles, and trojan horses. Given the increasing dependency of organizations on information retained and processed by computers, end users of data processing technology should understand the basics of what a computer virus is, what it does, how to prevent a virus infection, how to detect the presence of a virus and how to defend against a virus attack. In the long run however, there is no defense better than a strong program of external security and internal controls designed to prevent and/or detect the existence of malicious code, however that code may be classified or what it may be called.

Introduction

It sneaks in on a floppy, by modem or over your network. At first, you see nothing, or maybe a few glitches. Then it spreads, replicating in every file, in every folder. Destroying irreplaceable data. Permanently. Left unchecked, it could ruin all of your hard disk data and shut down an entire network.[1]

The damage is done; it is too late to save the valuable data erased from your hard disk; you have been struck by a computer based self-reproducing program (SRP), more commonly called a virus. With the multitudes of professionals relying upon computers, you may either have been affected by or know of a colleague who has fallen prey to a virus of some type. Gone are the days of "care free" computing. Gone are the days of a child-like innocence towards computers. Users have finally begun to realize the importance of the data computers retain and the necessity of securing that data. Proactive policies and procedures, not reactive rhetoric, are required now to secure systems and limit their exposure to unauthorized access, computer viruses and other malicious code.

This paper has four objectives in providing the reader with practical insight into keeping your computer virus-free. The first objective is to define the term and concept of "self-reproducing program," as well as variant but related genera (i.e. viruses, worms, moles, bombs, holes, trojan horses and trap doors).

The second objective addresses how an infestation can occur. Adequately covering this objective requires the presentation of some technical concepts. These concepts are presented only when absolutely necessary and are fully explained so that they will be easily understood by the technical as well as the non-technical reader.

The third objective examines the implications of "an infestation" on a computer and its resident data, answering the question, "Why should I even be concerned about viruses?"

Once we have a firm understanding of why controlling self-replacing programs is important to the financial success and stability of any organization, the final objective is to present a strategy for establishing solid internal controls, designed to control the proliferation of self-reproducing programs and related genera.

From Bugs to Bombs

In data processing the term long used to describe a glitch in processing logic or a programming fault is simply a "bug." This annoying and potentially damaging (to data, information, and processing schedules) creature is unfortunately an accepted "cost-of-doing-business" within data processing. Although confronting a bug in your programs or system is frustrating and most often means additional hours of labor trying to eradicate the bug or solve the problem, this poor little bug has never struck much *deep-seated* fear in the hearts of data processing professionals and end-users. Individuals simply acknowledged the bug's existence, accepting that a "fix" would be found or designed to rectify the problem, the bug would be removed/corrected, and processing would continue along. Processing did continue along undisturbed until that fateful day in 1984 when the term "virus" leapt from the medical lexicon full force into the data processing main stream.

Virus—just the mention of the word causes users to break into a cold sweat. With the increased dependency upon data processing to record, analyze, compare, retain and present data in the form of information, the loss, destruction or manipulation of that data can bring a user, a department, a division, or even an entire company to its knees.

A rather young relative to the bug, a virus (as defined by the data processing profession) is a piece of program code containing self-reproducing logic, which piggybacks onto other programs and cannot survive by itself (i.e., without a host). The computer virus has received much attention from the popular press, but it is actually just one of several species of self-reproducing logic programs (SRPs). Several key differences distinguish SRP's from one another.

Consider the worm, a variant of a self-reproducing program, which is a collection of source code statements (i.e. a program) capable of replicating themselves and, unlike a virus, are not dependent upon a "host code" for their mere existence. This nasty little creature will eat away at valid data sectors, cramming memory and bringing the processing capabilities and capacities of your machine to a near stand still.

Yet a third species of SRP can wreak havoc on computer systems: the mole. A mole, as viewed by data security professionals, is a program which enters a computer system's software (through a math skills tutorial program, for example) via a method not normally allowed or known to exist. For instance, a software application (in this case, the math skills tutorial program) might allow the use of the control (CTRL)/Break Key sequence to exit the program, bypassing the normal, controlled log-off process, and placing the end user at the operating system level/shell instead of logging her off the system. A successful mole gives its creator unauthorized access to your entire system.

Leaving the animal imagery behind, we encounter a second classification of threats to your computer's safety and security. These too are often mistakenly lumped into the general group as viruses, but they do not meet the formal definition of an SRP. Instead, they are structural weaknesses within the system and must be considered separately.

A hole is a weakness in the operational aspect of a program or system (accidentally designing file-open instructions with no matching file-close instructions, for example); such a weakness allows unauthorized users to access other programs and/or gives them system privileges.

Following the same pattern and pretty much along the same lines is the trap door, a hole intentionally built into a program or system by the programmer. This secret access-way is usually coded into programs to aid the programmer in debugging (seeking out logic problems and correcting them), but trap doors may be built for nefarious purposes, as well. A perfect example of a trap door was dramatized in the movie *War Games* when the teenage hacker enters the special password "Joshua" and gains unrestricted access to a mainframe computer at NORAD headquarters.

A third threat within this secondary grouping is the trojan horse, a functional piece of code introduced into a program and dedicated to secondary tasks that benefit the intruder, who has implemented this harmful code. For example, a trojan horse can be designed to deteriorate the performance of a system, to destroy data or to obtain information.[2]

Rounding out our examination of the broad spectrum of computer security threats is a cousin of the SRP—the bomb. A bomb is a series of source code statements which are activated when a certain logical or physical criterion is met. Typically, when defining a bomb in this context, two sub-categories of bombs are identified: 1) a time bomb, which is activated by a date and/or a time trigger (i.e. the Columbus Day "virus,"

the Friday 13th Com Virus, etc.); and 2) a logic bomb, which is activated by an event (i.e. the sign-on program has not received any log-on ID in over a 20 day period).

Holes, moles, trojan horses, worms, viruses, time bombs—each of these data destroyers has its own unique "DNA," a pattern or composition which defines its makeup, its general being. The bottom line, however, is that any of these programs can disrupt the day-to-day operations of one or hundreds of computers. The potential financial loss due to the destruction or manipulation of data via a virus attack for most organizations is staggering. The potentially destructive nature of self-reproducing programs, for instance became apparent on November 2, 1988, when the Internet (a global computer network built around the Defense Department's Arpanet system) was invaded by a worm program. In less than two days, an estimated 6,000 UNIX-based computer systems on the Net were infected. Estimates of the cost of this incident to the organizations affected (for cleanup and testing to ensure the worm's eradication was complete) are in the millions of dollars.

Now that we have established a firm base of understanding regarding the various types of malicious code which abound today, we are a giant step closer to being able to protect ourselves and our computer systems. For simplicity, the remainder of this paper will focus specifically on SRPs and their potential impact on day-to-day computing.

DOS Dissection—A Review

Before diving directly into a detailed explanation of exactly how a virus does its "dirty work" within your programs, files and computer systems, I will take a moment to review several basic concepts of DOS (Disk Operating System) disk architecture. This is done here to; 1) to minimize the technical information which needs to be presented later and 2) to emphasize the damage that a virus is capable of accomplishing.

Disk Organization—General

A disk or diskette is organized in tracks and cylinders (a 5 1/4 diskette has 40 or 80 tracks depending on whether it is double sided or high density); each track is divided into sectors of 512 octets each (DOS version 3.X allocated 9 sectors per track). An integer set of sectors comprises a cluster. The first 12 sectors (beginning on the first side of the diskette in the first sector of the first track), numbered from 0 to 11, contain the following basic information:

- The boot sector (sector 0) contains information on disk, the boot program, and instructions to branch to IBMBIO.COM and IBMDOS.COM

- The File Allocation Table (FAT) (sectors 1 and 2) contains sensitive information for DOS such as the disk type, the status of each cluster (free, used or bad) and the link to files.
- The File Allocation Table second copy (sectors 3 and 4) is a replication of the first FAT.
- The root directory (sectors 5 through 11) contains 32 octets of information on each of the files stored: eight for name, three for extension, size, date and time of creation, and attribute (system, hidden, read only, archive).[3]

Disk Organization—Technical

When a diskette or a hard disk is formatted, creating the root directory, the following DOS files are established:

- IBMBIO.COM (sectors 12 to 21)
  The part of DOS that communicates with the computer's peripherals is called BIOS, which stands for Basic Input/Output System. The BIOS consists of routines that provide some control for the keyboard, video display, disk drives and other peripherals. The BIOS gives programs a standard way to communicate with these peripherals and to control them.

The disk file IBMBIO.COM (called IO.SYS for MS-DOS {Microsoft Corporation's version of DOS versus IBM's version of DOS} machines) is the file which holds the next level of software routines for controlling and communicating with peripherals. The IBMBIO.COM file is hidden from view when created and placed on your disk(ette). If you intentionally erase or alter the IBMBIO.COM file, you cannot properly use the operating system on the altered disk(ette).[4]

- IBMDOS.COM (sectors 22 to 55)
  Like IBMBIO.COM, IBMDOS.COM is a system file that is hidden from view when created and placed on your disk(ette). This file contains the major part of the operating system and holds the routines for controlling the information passed between the computer and its peripherals.

As the control center, IBMDOS.COM communicates its directions to the BIOS (Basic Input/Output System). The BIOS, in turn, does the actual "talking" to the devices and transmits the filing system's directions.[5]

- COMMAND.COM (from sector 56)
  The command processor, COMMAND.COM is the program by which you communicate (via keyboard input) with the computer to tell the rest of DOS what to do. COMMAND.COM displays the A:> (C:>) prompt on the monitor when you start DOS. This prompt indicates that you are talking to COMMAND.COM. Other functions that COMMAND.COM handles include processing batch files, executing batch file subcommands, redirecting input/output and the most frequently used function—loading external DOS commands and application programs into memory, thus giving them control of the computer.[6]

If you did not create a bootable disk (by selecting the /S option) at format time, (thereby creating a data disk instead), COMMAND.COM data is stored beginning at sector 12.

The preceding description of the logical organization of a disk(ette) highlights the vulnerability of the first 11 sectors: FAT, sectors one to four, and the root directory, sectors five to eleven. These sectors constitute the "heart" of the disk(ette); altering these sectors could mean the complete loss of data stored on the disk(ette). These 11 sectors are prime targets for most invasive programs, including viruses, worms and trojan horses.

How a Virus Works

Even more susceptible to virus infection, however are COMMAND.COM, IBMBIOS.COM and IBMDOS.COM files. Why? Because these files contain the RAM (Random Access Memory) resident part of DOS. These files are always executed when your computer is turned on, which provides easy replication of the virus, and their location on disk (sectors 1-11) is well known and easily addressable.

A virus could get its start in one of many ways: from copied pirated software, public domain software, or shared software. When this software is loaded into your computer, the virus takes over. Take as an example a virus which is hidden in a free utility. When you download a program from a bulletin board via a modem onto your hard disk or diskette, you inadvertently bring with the program any disease it might contain. When the virus is activated in response to some stimulus, it executes the utility function and inserts malicious code/instructions into COMMAND.COM on your computer's hard disk. The virus copies itself onto floppies when a DOS Directory (DIR) Command is executed. At this point, the virus is not apparent on infected floppies and will travel and propagate throughout an entire organization, infecting every machine (hard disk) and floppy it comes in contact with.

When the infected floppy is loaded into another user's computer, the virus loads instructions into RAM. Then, when the system reads the floppy, the virus in RAM deletes files and copies the virus code into the hidden files (IBMBIOS.COM, IBMDOS.COM). Since data loss from a virus infection is highly probable, the infected floppies *may* lead to the discovery of the virus, but tracking the virus to its original "carrier" may no longer be possible.[7]

Infection via an external diskette is not the only way a virus can propagate! A computer virus can spread to a "clean" computer system whenever the computer program in which the virus is included is connected - directly or indirectly - to a clean (uninfected) computer. Thus, a particular virus may be propagated through the telephone lines or cables connecting computers in an on-campus network.[8]

Possibly even more frightening is the fact that a virus can gain access to your computer system through what would have appeared to be a safe, protected and impossible route: software purchased legally from a vendor in its original, shrunk-wrapped package! This was indeed the case in 1988, when Aldus Corporation, vendors of desk top publishing software, inadvertently shipped hundreds of copies of a new software product containing a virus which had crept in from a testing site. On March 2, 1988 a "universal message of peace" from a Canadian publisher appeared on the screens of all Mac (Apple Macintosh) computers on which the Aldus software had been installed, then deleted itself. Fortunately, this virus was a relatively benign one; its greatest impact proved to be the warning that even new software can be diseased.[9]

How Do You Know If Your Computer Is Infected?

With a virus of the biological type, certain external signs or symptoms indicating infection are apparent: chills, fever, runny nose, etc. Fortunately, a computer virus also causes symptoms which can lead to its detection. Some of the more openly apparent symptoms of a virus infection are listed in Table 1.1.

- Signs of slower than normal computer operations
- Access to disk when you haven't requested something from the disk
- Less memory available than there should be
- Unexplained losses of or changes to data
- Obsolete user accounts being activated
- A disproportionate number of computations required to process a relatively simple instruction
- Appearance of unfamiliar graphics or messages
- Changes to file sizes and date stamps of last file usage date
- Devices being activated that are not needed by the program currently executing in memory
- Sudden increase in free space on the hard disk
- Conversely, a sudden increase in the number of bad sectors on the disk
- A reduction in unallocated RAM
- Missing and/or altered data, including the insertion of extra characters or lines of code within an application.
- The alteration of hardware/firmware, such as the marking of clean disk space as unreadable, the resetting of the system's clock

Table 1.1 Symptoms of a Virus Infection

What Kind of Damage Can a Virus Do?

A computer virus can cause substantial harm simply by replicating itself many times and using up disk space and computing power in a computer system. In addition, a virus can delete or damage other computer files. Depending on the nature of the adversely affected program or file, substantial damage may be done to a wide range of different interests. A related type of harm, however, is the burden of cleaning up the system - removing, checking and replacing files after a virus has been detected. The technical services required to remove a virus may be very expensive, and missing even a single copy of a virus may cause the problem to recur.[10]

Even if no new viruses are created, the cost to the worldwide micro computing community is likely to exceed $1.5 billion simply to periodically remove already existing infected software. The potential costs involved in lost data, system downtime and recovery efforts are likely to exceed $5 billion to $10 billion dollars in the next five years, according to Peter Tipzrett, president of Foundationware, Inc., a Cleveland-based publisher of antivirus software.[11]

Harold Highland, an expert on computer viruses and editor of the *Computer Virus Handbook*, states that companies soon will be considering the employment of "two top-notch micro people" who are charged with educating users about sound computer practices, scanning all software that is brought into the company and cleaning up virus outbreaks whenever they occur. This "SWAT" team and hardware could cost between $120,000 and $150,000 per year, Highland estimates. "[Firms] are going to have to accept it as a cost of doing business in the same way a retail store factors in the cost of shoplifting," he says.[12]

Are Colleges and Universities Especially at Risk?

Probably. Institutions of higher learning often have an unusual concentration of people with computer expertise and the freedom and incentive to explore frontier technologies. Unfortunately, the creation of computer viruses has developed a reputation as a challenging and intellectually intriguing activity. In addition, students and faculty often copy and exchange computer software, including software that has not gone through regular commercial channels and therefore carries the greatest risk of computer virus infection. Moreover, much college and university computing takes place in the context of computer centers and large networks, which can offer ideal conditions for the spread of computer viruses.[13]

Ramifications and Potential Financial Impact of a Virus Infection—The Academic Arena

Someone damaged by a computer virus may seek to recover compensation in a civil lawsuit and may seek a defendant with "deep pockets." In view of the wide range of activities in which a modern university or college [or in reality any organization] computer center may be involved, it is, unfortunately, not difficult to imagine the kinds of damage claims that may be asserted if a virus causes widespread destruction of computer files. For example:

- A financial institution, off-campus, could lose key records and suffer serious harm from a widely distributed virus, and may feel compelled to assert a claim against the institution in whose facilities the virus originated;
- A virus in an on-campus hospital could destroy or alter medical records, potentially causing serious harm to patients;

- A consulting firm working with a faculty member may seek to recover the value of revenues lost because of a default caused by a disruptive on-campus virus.

To the extent that a virus travels along a network to other facilities, the risk of liability is correspondingly increased. The liability that a college or university faces in such circumstances can be divided into three categories. First, the institution might conceivably be held responsible for the conduct of a student who introduces the virus into a computer system. Second, the institution may be held liable for the actions of its employees, including faculty members, staff, graduate students receiving financial compensation, or undergraduates employed on a part-time basis. Finally, apart from this kind of "vicarious" liability, the institution may face exposure to liability as a result of its role as a provider of computing services or for failure to use reasonable care to avoid foreseeable harm to others.[14]

What Can You Do to Ensure You Will Not Get Infected with a Virus in the Future?

Before detailing specific measures you should take to protect data and computer systems from virus infection, a brief discussion of the nature of internal control(s) is in order.

Internal control can be defined very simply as the means by which errors in accounting data are detected and corrected. A more comprehensive definition of internal control is that it comprises the plan of organization and all of the methods and procedures adopted by a business [or "business" entity] to safeguard its assets, check the accuracy and reliability of its accounting data, promote operational efficiency, and encourage adherence to prescribed management policies.[15]

For our purposes and to focus more directly on controlling viruses, this basic internal control definition needs to be expanded. Internal control—or better yet, achieving a level of internal control - consists of implementing three separate stages or classifications of controls - Preventive, Detective and Corrective.

Simply put, *preventive controls* stop errors or irregularities **from** occurring; *detective controls* identify errors and irregularities **after** they occur; and *corrective controls* **remove** or **reduce** the effects of errors and irregularities after they have been identified.[16]

One additional term needs clarification—exposure. An exposure is the combination of a threat, an asset, and a vulnerability. Determining your susceptibly to an exposure requires three major tasks:

(a) identification of the controls in place and an assessment of their reliability, (b) evaluation of the likelihood that a threat will be successful given the reliability of the controls that are in place, and (c) assessment of the loss that will result if a threat circumvents the controls that are in place.[17]

Even a single virus poses a threat/exposure to the security of your computer system and the integrity of data which may reside within it. The question now remains: "How can we limit our exposure by implementing aggregate controls?"

Internal Controls

The following internal controls are not listed in any particular order of importance or sequence of use and represent only a small sample of recommended control procedures. The author is aware that there may be additional controls, not listed here, which may work equally as well. These controls may not work in all cases nor in all operating environments. The user must determine which controls are best suited for the environment and situation into which they will be placed, and for the particular exposure the user wishes to control.

The reader should understand that as new viruses are developed and unleashed on the computing community, the ability of some of the listed controls to perform as intended may be seriously impacted, if not rendered obsolete!

Specific Control Practices

- Write protect all system and program diskettes and establish read-only system files on hard disks. Make all of your .COM and .EXE files **read-only**. Under DOS 3.3 (and higher), you can do this with just two calls to **ATTRIB** (the DOS command which sets file attributes), one for .COM and one for .EXE. From your **root directory**, enter the command ATTRIB +R*.COM/S. The /S switch causes ATTRIB to execute the command in all sub- directories. Do the same for .EXE files.
- Move COMMAND.COM out of the root directory. Edit your CONFIG.SYS file to include a line like: **SHELL=C:\HIDDEN\COMMAND.COM/P** replacing HIDDEN with whatever directory you choose to "hide" or keep the COMMAND.COM file in. Add the line: **SET COMSPEC=C:\HIDDEN\COMMAND.COM** to your AUTOEXEC.BAT file.
- Create an emergency boot disk that contains copies of original programs (i.e., DOS) and files (i.e., COMMAND.COM, CONFIG.SYS, AUTOEXEC.BAT).
- Use the DOS SORT command to sort each of your subdirectories by data and time. Any date prior to 01/01/80 should be suspect, as should any "far reaching" future date as well as dates that contain 00 (double zeros), or any time greater than 23:59:59.
- Sort each subdirectory by file size. Look for any unusually large files or files with a size of 0 (zero) bytes. Compare file sizes with a control copy; any unexplained changes in COM, EXE, .BAT, or .SYS files should raise a warning.
- Use the DOS ASSIGN command. Before you load a suspect program, type **ASSIGN C:=A:** at the DOS prompt and press the enter key. If a virus program then tries to access drive C:, DOS will send the call to drive A: instead. At this point, you can run the program and inspect it for a virus. Once you are satisfied that the program is clean, undo the ASSIGN command by typing ASSIGN and pressing the enter key.

Inoculations—The Antivirus Movement

A discussion of viruses and their destructive ways would be incomplete without a review of antivirus software - the computing community's "ray of hope". Antivirus programs, generally, perform one or more of the following functions: prevention, detection and identification control.

Virus Prevention

Prevention products keep the virus from infecting your system in the first place. They forbid changes to executable files so the virus can't get a foothold.[18] Antivirus prevention techniques are classified at three levels:

Level I—Techniques for Keeping Viruses Out

Approved Program List—Blocks any program from executing which is not on the list.

Known Virus Check —Scans all executable files on hard disk for all know viruses (as of package's purchase date).

Suspicious Code Search—Checks for suspicious commands such as low-level disk writes.

Approved TSR List—Warns user if any program not on the list attempts to terminate processing yet stay resident (TSR) in memory.

Level II—Techniques for Preventing Replication

Write Protection—Prevents writing to protected files on disk.

Signature Check Program —Takes a "signature" of all approved programs and compares the current program to be run, with the signature of the authorized program.

Run-time Signature Check—Whenever DOS loads a program, a check is made against the signature. The antivirus program will "block" the program from executing if the signature does not match.

Level III—Techniques for Blocking Malicious Tricks

Disk Access Lockout —Allows access only through DOS file functions. This will prevent reformatting and erasure of the File Allocation Table (FAT).

FAT Copy—Makes and saves a copy of the File Allocation Table in case a virus does manage to damage it.

CMOS Copy —Makes and saves a copy of the CMOS information just in case a virus manages to damage it. In PC-AT type machines, important parameters such as type of hard disk used, memory size, etc., are stored in non-volatile memory called CMOS. If these parameters were to be modified, a problem would occur when the system was rebooted.

Hard Disk Lock—Will temporarily block all access to the hard disk while testing suspect software.[19]

Virus Detection

This class of [antivirus] products spots infection soon after it has occurred and marks the specific components, or segments, of the system that have been infected. Although not as good as virus prevention, it is an acceptable alternative.[20]

Virus detection can be subdivided into distinct processes, code examination and code execution. Code examination is an automated review of an individual program's code to detect a computer virus BEFORE it executes. This code examination should be made on all new software. There exist three separate areas of code examination:

1. Text Strings: Used to search for code that reflects [or matches] a known virus.
2. Instruction Analysis: Looks for suspicious instructions, such as writing to the FAT or duplication of itself.
3. Code Block: This analysis is a bit more complex. It analyzes sets or blocks of text strings or instructions to determine if they act like a virus.

A computer virus may be detected by using code examination through one of the three methods described below:

1. Padded Cell: Placing suspect software in an environment where it cannot hurt anything, and letting it execute (i.e. loading software into a test environment and running it).
2. Step-through: This procedure consists of a debugging or text environment that allows for the examination of system and program states while stepping through the software execution.
3. Trap or Filter: This is a hardware and/or software technique that looks for defined viral activities. Upon finding one, it asks the user whether to proceed or call a security group for assistance.

The benefits of code examination to the user include:

- Its relatively low cost;
- Its effectiveness against known viruses;
- The fact that no major change in user's present system is required;
- The fact that it is quick and easy to use;
- The need to be done one time only;
- The ability to catch viruses BEFORE damage is done.

Code execution methods for detecting computer viruses center on catching the virus as it begins to operate. This detection occurs during execution by looking for "viral activities," which can be defined as, but are not limited to:

- Access to software for the purpose of modification
- The creation of a new executable program that was not one of the intended results of the process being performed
- Examination of system settings
- The expansion of a program's system privileges
- Writing to an absolute section of the disk
- Modifying system control parameters
- Bypassing normal operating system functions[21]

Virus Identification

Finally, in our discussion of antivirus software, are antivirus programs which try to identify known viruses by looking for specific byte patterns. This isn't a very practical method, as a tiny change to the virus code can defeat the antivirus program.[22] Virus identification software should be used in conjunction with other virus prevention and detection methods.

Recovering From a Computer Virus

If all the techniques previously discussed fail and you are sure that your computer system has been infected by a virus, the following eight steps should put you back on the right track to data integrity:

1. Isolate the affected system(s).
2. Identify and analyze the source of the threat.
3. Back up all data on the affected system [to separate disks].
4. Remove all programs and operating system software from the affected system.
5. Initialize all storage media for the affected system.
6. Replace the operating system software and vendor application programs from their *original backups* at off-site locations.
7. Recompile in-house developed programs from backup copies of their source code.
8. Restore production data on the system from back-up copies at off-site locations.[23]

Summary

Computer viruses *are* the ultimate terrorist act. Viruses will not simply disappear, in fact, they are a growing menace. With the ever increasing dependency on computers to store our data and process it to provide us with information, the potential for corruption of data integrity has never been higher. The threats and liabilities posed by viruses requires a pro-active stance - identification of exposures and implementation of solid internal controls.

Ultimately your PC can never be too secure; however, security and controls must not interfere with daily work routines. By recognizing the warning signs, eliminating or at least reducing the potential for breeding, and practicing safe computing, computer users can indeed keep in check viruses and malicious code of all types.

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Glossary of Key Terms

Cluster	The smallest unit of disk space that DOS will work with in the File Allocation Table (FAT).
Data	A representation of facts, concepts or instructions in a formalized manner suitable for communication, interpretation or reprocessing by human or automatic means.
DOS	Disk Operating System. A collection of programs that direct and aid in the management of the computer's resources. A *disk* operating system also controls the use of disk drives for the storing and loading of programs and data.
Floppy Diskette	Got its name from the flexible jacket that houses the magnetic recording media (the disk): The diskette "flops" when you shake it. Technically the 8-inch diskettes are called floppy diskettes and the 5.25-inch version is a minifloppy diskette. The 3.5-inch hard cased diskette naturally is called the micro floppy. Industry usage has blurred the terms, lumping all diskette sizes into a common term - floppy diskettes.

Hard Disk	Does not use diskettes, but rather rigid, circular platters coated with metal oxide. These rigid platters give the "hard" disk drive its name. They are fixed on a spindle that rotates about 3600 RPM.
Modem	A device that modulates and demodulates signals transmitted over data communication facilities (i.e. telephone lines). One of the functions of a modem is to enable digital data (from a computer) to be transmitted over analog (telephone) transmission facilities.
Network	A complex consisting of two or more interconnected computing units.
Object	The language or set of coded instructions into which a sourcelanguage (code) is translated by means of a compiler.
Operating System	See DOS.
RAM	Random Access Memory. The portion of your computer's memory that is volatile (memory which does not retain stored data when power is cut off).
Root Directory	The starting directory of every disk. It holds program or data files but can also holdthe names of other directories. These additional directories are called subdirectories.
Sectors	A part of a track. The use of tracks and sectors allows the computer to move the disk drive recording head rapidly to the correct spot.
Software Application	A program written for or by a user that applies to the user's work (i.e., a payroll application, an airline reservation application, a network application).
Source Code	A programming language which cannot be directly processed by the hardware of a computer but requires ompilation into an object program consisting of instructions in a machine language which can be directly understood by the computer.
Tracks	To simplify the handling of a disk or diskette, DOS breaks the diskette down into smaller pieces. Tracks are a series of concentric circles, encircling the disk or diskette.

Paper (M4-06)
The Platform Problem: An Educator's Perspective

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Abstract

Most educational software will run on one, but only one, of the three microcomputer platforms most commonly used today in educational institutions. The various platforms are incompatible because of fundamental differences in their central processing units, because of differences in their handling of input and output, and because of other differences in their operating systems. Higher level languages could, in principle, mask these differences and permit compatible versions of educational programs to be produced from common source programs, but in practice current microcomputer compilers are not designed with this capability. The problem has existed since the early days of educational microcomputing although the list of dominant platforms has changed over the years.

Partial solutions, in addition to higher level languages, have included portable operating systems, portable development environments, and emulators.

Educators should understand the platform problem and evaluate software thoroughly before making hardware commitments. Educators should also be aware of current trends and likely future directions in platform development and in operating systems.

Educational programmers can produce portable software by anticipating the platform problem and preparing a set of low-level routines to mask incompatibilities among their chosen compilers before designing and writing the body of the desired program.

Eventually, portable operating systems now under intensive development by various major vendors may allow most educational software to run on most computers.

Introduction and Informal Definition

Most educational software will not run on most microcomputers. That is the essence of the platform problem. This paper discusses the sources of the problem and solutions that have been attempted in the past. It also discusses the current state of the problem and possible solutions for both educational software users and educational programmers. Finally, it considers probable changes ahead with emphasis on planning for the future of educational computing.

The Platform Problem As It Exists Today

A microcomputer operating system is the lowest level program which a microcomputer executes. The operating system provides the user with a means of managing files and of selecting desired applications. It provides the programmer with a way to access the computer hardware. The relationship is illustrated in Figure 1.

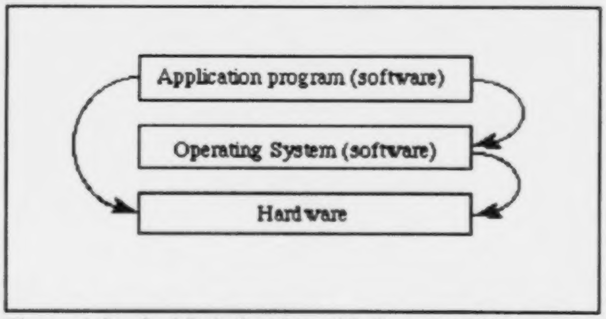

Figure 1. Logical Relationship of Software and Hardware (Arrows indicate that one level makes major assumptions about another.)

Each microcomputer model in use in educational computing today primarily runs one operating system and most educational application programs require a specific operating system.

A platform, as the term is used in this discussion, is a set of microcomputer models which are all capable of running a large common body of application software. An alternate definition, roughly equivalent to the first, is that a platform is an operating system together with all the computer models capable of running that operating system. There are three major microcomputer platforms used in education from elementary schools through lower division college courses. These are (in order of appearance):

1. The Apple II platform. This platform comprises all the Apple II models manufactured by Apple Computer, Inc. since about 1977 together with compatible machines marketed by Franklin, Laser, and other companies. The primary operating system for these machines today is ProDos although there have been others (The DOS Manual, 1980).

2. The PC platform. This platform includes all IBM PC and PS/2 models dating back to 1981 and a lengthy list of "compatible" machines marketed by numerous other manufacturers (Bradley, 1990). The primary operating system for this platform is Microsoft's MS-DOS which is, for most purposes, equivalent to IBM's PC-DOS. Other operating systems have existed in the past for this platform (Sheldon, 1991) and still others are currently available or under development, but at present the dominance of MS-DOS is such that the others can be ignored until the final chapter.
3. The Macintosh platform. This platform comprises all the Macintosh models introduced by Apple Computer, Inc. since 1984 and a few compatible models from other sources (Crabb, October 1991). The primary operating system for these machines is the Macintosh Operating System.

The platform problem in its present form in educational microcomputing exists because of the following combination of circumstances:

1. No one of these platforms is truly dominant in educational microcomputing today.
2. A disk containing an application program written for one platform usually cannot be run on a microcomputer belonging to another platform.
3. It is usually difficult to convert a complex program written for one platform to a functionally equivalent program for another platform, and few educational programs justify the required investment under current market conditions.

Therefore, educational programs are usually designed, written, tested and published for just one platform.

Microcomputer Architecture Simplified

All of today's microcomputers consist, logically if not literally, of three primary hardware subsystems: (1) a memory unit, (2) a collection of peripheral devices including at least a video monitor with graphics capability, a keyboard, and one or more external storage devices, and (3) a "central processing unit" or CPU. Each contributes to the platform problem differently.

Memory

All microcomputers have memory which is equivalent for the purposes of this discussion. It is organized as a large number of storage locations each holding a number from 0 to 255. Although some programs cannot be executed on some computers merely because of an insufficient number of memory locations, and some memory locations bear a dedicated relationship to certain hardware functions, these memory problems are not central to the question of platform compatibility. Memory may be regarded as functionally identical on all current machines and thus not germane to the platform problem.

Peripheral Devices

Peripheral devices are more problematic. Modern graphics monitors, on whose screens each individual dot is separately illuminable, vary widely in both the number of discrete dots displayed and in the characteristics, such as color and intensity, which each dot may possess. Different platforms use different schemes for controlling the display and require different types of instructions to produce similar displays. Keyboards also vary widely in the number, position and labeling of their keys. There is some variation even among keyboards designed for machines of the same platform and large variation among keyboards for different platforms. External storage techniques and means of accessing other peripheral devices also differ from platform to platform (Apple II Reference Manual, 1979; Inside Macintosh, 1985-1986; Guide to Operations, 1983).

The CPU

It is the differences among the various CPUs, however, which cause the seemingly most fundamental problems of platform incompatibility. Each of the platforms under discussion is based on a different family of CPUs. Within each platform the CPUs are largely compatible. In particular, programs which run on the CPU used in one computer belonging to a given platform usually run identically on all later CPUs for that platform, as suggested by the first definition of platform. Thus, programs written in 1977 for the Apple II+ run identically on the Apple IIgs, which is undoubtedly a major factor in the continuing success of the Apple II platform in education (Thornburg, August 1990). On the other hand, a program which runs on a machine belonging to one of these platforms is normally incompatible with any CPU from a different platform since the second CPU responds differently to the same program instructions stored in the same memory locations. For example, Table 1 shows what happens in one typical case, depending on which CPU family is executing an instruction.

This example is typical and illustrates that, at the CPU level, there is total incompatibility among platforms. There are other platforms, such as the Commodore Amiga, which share CPU's with one of the platforms discussed above. The Amiga uses the same 68000 family used in the Macintosh (Ryan, 1990). However, the Macintosh and the Amiga have incompatible operating systems which makes them, for practical purposes, almost as incompatible as the various platforms with incompatible CPU's. This explains why "platform" was not defined directly in terms of the CPU family.

A Short History of Platforms in Educational Microcomputing

As of 1979, there were already three principle platforms established in educational microcomputing. They were the Commodore Pet, the Tandy Radio Shack TRS-80 and the Apple II+ (Thornburg, July 1990). The use of the word "platform" here is perhaps misleading because each consisted of just a single computer model. The problem of software incompatibil-

Table 1. CPU Incompatibility.

Result of executing the instruction at location 1000 if locations 1000 and 1001 contain 16 and 5, respectively (all numbers in decimal notation).

CPU family	*Platform*	*Action Taken By CPU*
6502,65C02, 65802,65816	Apple II	Consults the sign flag in the CPU; if it's 1, takes the next instruction from location 1002, but if it's 0, jumps to location 1007 for the next instruction (Leventhal, 1979).
8088,8086, 80286,80386, 80486	PC	Adds the contents of the CPU's AL register and the carry flag in the CPU to the current contents of the memory location whose address is in the CPU's DI register. Sets the carry flag to 1 if a carry results or to 0 otherwise (Wyatt, 1987).
68000,68020, 68030,68040	Macintosh	Copies the lower 8 bits of data register 5 in the CPU to the lower 8 bits of data register 0 in the CPU (MC68000 Manual)

ity, however, existed among these platforms just as it does among today's major platforms.

Over the next few years Commodore introduced several more powerful microcomputers most of which were incompatible with all earlier models. Its failure to maintain compatibility probably prevented Commodore from retaining a significant presence in educational microcomputing.

Tandy Corp. upgraded its TRS-80 line several times with mostly compatible machines. However, Tandy ceased supporting its TRS-80 platform around 1984 and turned to producing primarily PC-compatible machines. Tandy remains a factor in education as one of the leading producers of compatible machines for the PC platform.

Thus, as the 1980's progressed, two of the initial three leading educational platforms vanished and were replaced by the PC and Macintosh platforms. Educators continued to be faced with a choice of platforms, no one truly dominant, although the Apple II enjoyed a substantial lead for a considerable period of time. Educators were also offered an increasing variety of educational software most of which would run on only one platform.

Some Partial Solutions to the Platform Problem

Higher Level Languages

The most important step toward what may one day be a complete solution to the platform problem occurred almost before there was a platform problem. It was about 1953 when the IBM Corp. undertook to implement John Backus' idea of defining a higher level programming language and writing a conversion program, or compiler, to translate instructions written in this language into instructions directly executable by a selected CPU. The result was the highly successful FORTRAN programming language (Appleby, 1991). If one compiler could translate human-readable statements to code executable by one CPU then another compiler could translate the same instructions to code executable by another CPU. This essentially solved the problem of CPU incompatibility, the most profound of the incompatibilities already discussed.

Higher level languages could have completely solved the platform problem. However, no sufficiently standardized, powerful and yet compact high level language with compatible compilers has emerged for the three standard educational platforms. Part of the problem is marketing. Popular languages such as C and Pascal have established standards for the core language (Kernighan and Ritchie, 1978; Jensen and Wirth, 1978). However, language vendors seek to differentiate their wares by adding extensions which compromise portability. These typically involve input and output, that is, management of the peripheral devices. Curiously, therefore, the fundamental problem of CPU incompatibility has essentially been solved by high level languages whereas the inherently less serious problem of incompatibility of peripherals has not.

The UCSD p-System

In the mid-1970's, Kenneth Bowles and his colleagues at the University of California at San Diego developed the UCSD p-system. This was potentially the ultimate solution to the platform problem. The UCSD p-system consisted of both an operating system and a set of compilers for various high level languages. The compilers produced a special CPU-independent "pseudo-code" or "p-code." Executing p–code required an interpreter program which read the p-code during program execution and caused the target CPU to perform the desired actions. The difference is illustrated by comparing Figure 1 with Figure 2. The interpreter is an extra level of software for each platform which presents a uniform interface to p-code programs. The upper levels of software make no assumption about the hardware, which is the key to portability.

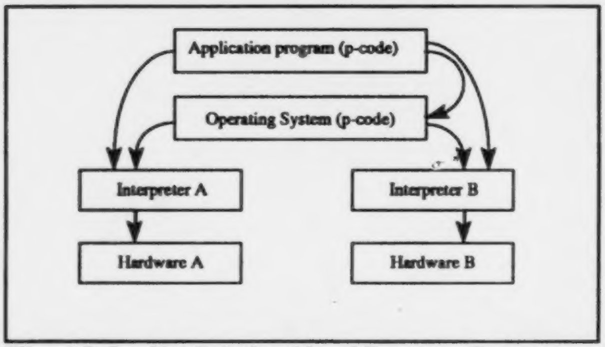

Figure 2. Logical Relationship of P-system Components (Arrows indicate that one level makes major assumptions about another.)

Any source program, its executable p-code, and even the operating system itself were completely portable in the p-system. Programmers' utilities such as the editor, linker and library manager were written in the p-system, so the entire programming environment was portable to any computer for which there was an interpreter. A p-system user or programmer was immediately "at home" in the p-system even on an unfamiliar computer. The p-system completely solved the platform problem (Willner and Demchak, 1985; Clark and Koehler, 1982).

Since the p-system has now almost disappeared, there evidently were some disadvantages to this approach. One was that interpreting p-code required extra CPU time, so programs ran slowly. Another was that p-system users were dependent on the vendors of the p-system to produce the software drivers needed for new peripheral devices, such as improved graphics displays. Also, the p-system was never widely promoted. Finally, the emergence of the IBM PC platform as the dominant business platform in the early 1980's reduced the importance of portability issues and allowed dedicated compilers to dominate the market. For example, Borland's Turbo Pascal improved upon UCSD Pascal in most respects other than portability and rapidly became the dominant Pascal compiler for the PC platform.

Other Portable Programming Environments

There have been a number of other attempts to produce portable programming environments. True BASIC from True Basic, Inc. and cT (formerly CMU Tutor) from Carnegie Mellon University both allow such portability between the PC and Macintosh platforms. Neither system, however, can produce programs for the Apple II platform. Neither has enjoyed major market success compared to less portable systems, so there is doubt about the long term survival of these and similar systems. There seems to be no widely available system offering true portability among all three major educational platforms.

Emulators

Another way to obtain software portability is by emulating the behavior of one machine and its operating system on another machine. This has been successfully accomplished on the Macintosh, which can execute PC programs when running Soft PC, a Macintosh program which causes a Macintosh to emulate the behavior of a PC. The problem with emulation, in principle, is that programs running in emulation mode execute much more slowly than they would in native mode on a comparable machine. Emulation also requires extra memory since both the emulator and the target program must be resident in memory. In particular, there seems no hope of emulating other platforms on the Apple II platform other than possibly on the Apple IIgs. On the Macintosh and the PC platforms emulation requires a much bigger and faster machine than would otherwise be needed. Typical academic budgets militate against such investments when so many more students could be served by purchasing more modest machines. On the other hand, as technology improves and speeds and memory sizes increase while prices decline, emulation may become increasingly feasible as a solution to the platform problem in educational microcomputing.

Platform Problem Strategies For Educators

Educators sometimes encounter the platform problem by discovering that the best software for their purposes does not run on their already installed platform. One strategy is therefore obvious. Software should be evaluated first and a platform should be selected only after the best currently available software is identified. Sometimes, however, money unexpectedly becomes available for hardware and must be spent within a brief period of time. The only defense is to have knowledge of available software even before there is any expectation of being able to purchase machines on which to run it.

Often the wrong people make platform decisions for educational institutions. Educational software usually trails business software in exploiting hardware features. This is probably because the business software market is more lucrative and more competitive than the educational market and because computers in educational institutions tend to be used much longer, so that new hardware features are slow to penetrate the installed base of educational hardware. Hardware features are therefore a poor way to select a platform for educational use. However, if the selection is left to hardware enthusiasts hardware features are the predictable criterion. Faculty and administrators whose first concern is learning must challenge seemingly knowledgeable colleagues by insisting that software availability is more important than hardware.

This caveat also applies to peripheral devices, such as printers and CD-ROM drives. Such devices are crucial for some software but a waste of money for other software. Educationally useful software that effectively exploits the capabilities of CD-ROM is particularly expensive to produce. Critical evaluation of software for its pedagogical merits should precede any commitment of funds to such hardware.

Another area which merits careful study before selecting a platform is networking. Platforms differ considerably in respect to the cost and complexity of installing networking and also in respect to the reliability, ease of use and capabilities of the available networks once installed. However, networking is beyond the scope of this paper.

An understanding of current trends and likely future directions for various platforms is also important when choosing hardware. Current trends are discussed in the final section of this paper.

A Model Solution For Educational Programmers

This section describes experiences and contains opinions of the author. It is much more subjective than the preceding sections. Accordingly, I shall use the first person. I shall describe a personal solution to the platform problem. A similar solution might be feasible for other software developers.

Languages and Compilers For the Apple II Platform

The selection of languages and compilers for the Apple II platform is limited. The best available compilers work only with the Apple IIgs. Applesoft BASIC was the universal programming language for the Apple II platform in the early years, but BASIC is one of the least standardized of high level languages and Applesoft BASIC is even less standardized than most other implementations of BASIC. Therefore, Applesoft BASIC programs are difficult to replicate on other platforms, and vice versa.

The best Pascal compiler available for the Apple II platform was Apple Pascal 1.3. However, it was a version of the p-system and suffered from the speed limitations and support problems mentioned above in connection with the p-system. Apple Pascal 1.3 is currently available from the Apple Programmers' and Developers' Association, whose catalog listing notes:

"Because this product has not been upgraded or revised to take advantage of new features in system software releases, ROM revisions, or computer model changes, it is intended for personal enjoyment only. We ask that you not use it to develop commercial software..."

"This is a class 3 restricted product. It is no longer supported and may not be compatible with current products... " (APDA, 1991).

Despite the preceding disclaimers, I have found Apple Pascal 1.3 to be a useful system although certain specialized knowledge is required to make it work correctly with some current hardware.

Joe Abernathy discusses C compilers for the Apple II in a recent article (Abernathy, 1990).

A Model Solution for Educational Programmers

I have moved two large educational software projects from one platform to another in the last decade. In the process I have discovered the ultimate programmer's nightmare. One should never have multiple versions of similar, but not identical, source text for a program being implemented on multiple platforms. The nightmare occurs when making changes, whether it be adding features, making general improvements, or correcting errors. Since all changes must be implemented and checked in all versions the likelihood of errors of omission, as well as of commission, is very high.

The essence of the strategy to be illustrated here is nicely summarized in a recent article:

"Layered software is... a key factor in the quest for interoperability. For example, applications that talk only to a small set of well-defined interfaces rather than directly to hardware can run (possibly after being recompiled) on any system that offers those interfaces. That's good, because it means more programs available more quickly on more different systems." (Van Name and Catchings, 1991).

Let us assume that a useful educational computer program has been designed and a list of target platforms specified. My procedure, the details of which could be modified as desired, was as follows.

a. I selected Pascal as my programming language.

b. I selected Apple Pascal 1.3 as my Apple II compiler, Borland's Turbo Pascal 5.5 (now upgraded to 6.0) as my PC compiler, and Symantec's Think Pascal 3.0 (now upgraded to 4.0) as my Macintosh compiler. Since only the latter two compilers support modern object oriented programming techniques I decided to use only standard Pascal variables, procedures and functions, rather than objects and methods (Apple II Pascal 1.3, 1985; Turbo Pascal, 1990; Think Pascal 1990).

c. I analyzed my planned program and the chosen compilers to determine all required operations for which the compilers do not support identical source statements. These operations predictably included keyboard input and screen output, disk input and output, and memory management, the areas where the platforms themselves differ and where the use of the high level language did not mask the differences. They also included other operations which are implemented differently, or not at all, by the various compilers.

d. For each compiler I wrote a Pascal unit containing low level routines to perform all necessary operations involving the incompatibilities located above. The unit interface, that is, the names and parameters of these routines, were the same in all units. Certain useful routines which were built in to some compilers were replicated for others. Of course, the inner methods of all these various routines differ, in some cases very significantly, reflecting the differences among platforms and compilers.

A version of the unit interface appears, suitably edited, in Appendix A. This unit provides low level support for two graphics screens, pop up windows, highlight menus, a mouse if available, personalized fonts, and framing, scrolling, flashing, saving and restoring of arbitrary rectangles on the screen. The unit supports, although it does not include, higher level routines for entry, display and editing of arbitrary mathematical expressions, equations and systems of equations containing nested exponents, fractions and radicals.

The common parts of the high level language, together with this unit, now form a standardized interface such that all the rest of the desired program can be written once and will compile on each of the target compilers. Thus, the problem of porting was solved initially, at the design stage, before the program was written. The project is now well along toward completion. For each platform the low level unit now requires less than 10% of the source text for the project. The other source text is, with trivial exceptions, identical for all three platforms. The nightmare described above is avoided.

The Future of Educational Platforms

Prospects for the Apple II Platform

For a decade, numerous industry analysts have erred in predicting the imminent demise of the Apple II. However, after introducing four new Apple II models between 1982 and 1986, Apple Computer, Inc. has introduced no further Apple II models and has not advertised the Apple II for several years. The company has, however, continued to upgrade both the ProDos and the GS/OS operating systems. According to one Apple II developers' publication, "Attendees at the National Educational Computing Conference in Phoenix, Arizona [1991] report that Apple Computer's exhibit did not sport a single Apple II computer" despite the fact that "over 60 per cent of the computers used in other booths were Apple IIs... ." (Doms, 1991). Given the emphasis of Apple Computer, Inc. on its Macintosh platform, it seems unlikely that there will be another Apple II model although the currently available models, the IIe and the IIgs, as well as the clones may continue to be manufactured and sold as long as they are profitable. In education, because of the immense library of available programs and the expertise of so many educators, the Apple II could remain a presence, albeit a gradually declining presence, for another decade.

Platform Proliferation

The Apple II platform may become less prominent in education, but new platforms may also appear. Although the PC and Macintosh platforms seem well established in education and resistant to alternatives, there are trends which already suggest the inevitable emergence of new platforms. Technology continues to advance and new types of CPUs and other chips will lead to new and better computer designs (Barron, 1990). In particular, a new generation of CPUs based on simpler, but faster, logical designs has theoretical advantages over today's CPUs, the latest generations of which have become increasingly complex. The name for this new type of CPU is the "reduced instruction set computing" (RISC) processor. Since the theoretical advantages seem to be realized in practice, RISC processors will probably be the basis of important new platforms in coming years (Glass, 1991; Fiedler, 1990; Marshall, 1990). Their penetration of educational computing is likely to be slow, however, because of the inertia of the large installed base. As usual, new hardware designs are likely to have their greatest initial impact in commercial applications and to permeate educational institutions much more slowly. Nevertheless, eventual platform proliferation in educational computing is probably inevitable as technology advances and software designers exploit the new possibilities.

Portable Operating Systems

Each operating system discussed above runs on a specific family of compatible CPUs. However, this is not a necessary characteristic of operating systems, as we saw with the p-system. A good current example is UNIX, a sophisticated, portable operating system long established in the minicomputer industry but not a major factor in microcomputing. However, versions of UNIX exist for most major microprocessor families. UNIX provides portability of source programs in high level languages. The solution suggested above for educational programmers using other operating systems essentially mimics the UNIX solution. By standardizing both the interface of the operating system and the interfaces of the compilers so that a given source program produces compiled programs which execute identically on any machine under UNIX, source program portability is assured. Problems have surfaced in the UNIX community as a result of competing proposed standards for graphical user interfaces and distributed systems (Scott, 1991). Nevertheless, UNIX may be a good solution to the platform problem.

A more likely development is that UNIX will provide a model for the solution. Another portable operating system may emerge as the solution to the platform problem (Davis, 1992). Portable operating systems are reportedly undergoing intensive development. Recent articles have speculated about Windows New Technology from Microsoft (Machrone, 1991), the PowerPC (Sheldon, Linderholm and Marshall, 1992), the "pink project" from Apple and IBM (Crabb, September 1991; ullman and Fisher, 1991) and Solaris from Sun Microsystems (Scheier, 1991). Each of these projects is reported to be well along toward initial release and to be designed for portability across various families of CPUs.

If inherent limitations which make portable systems large and slower than conventional systems can be satisfactorily overcome (Zachman, 1991), and if one of the new portable systems dominates the educational marketplace, the platform problem may find a software solution. On the other hand, if several of the new operating systems each achieves significant acceptance in schools, a new platform problem could emerge, this time at the operating system level. Developers and users must remain alert in this rapidly changing environment.

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Appendix A: A Low Level Pascal Interface, Edited and Annotated.

Comments are in braces, following the Pascal convention, and are edited to accommodate the presumed interests of the reader of this paper.

```
UNIT lowIo; INTERFACE
CONST
    {Constants to define a simulated text screen:}
            hChars=44;vChars=18;
    {Constants to describe special keys:}
            enterKey=13;escape=27;checkMenuChar=30;dimMenuChar=31;
            noKey=128;mouseDownKey=129;mouseMoveKey=130;mouseUpKey=131;
    {Miscellaneous constants:}
            maxPauseLevel=4;stdStringLength=89;
TYPE {Type names are uniform, but some definitions vary on different platforms}
            pointr=pointer;
            systemFile=FILE;
            stringStd=string[stdStringLength];stringBig=string[255];string1=string[1];
    {Types used by graphics display routines:}
            xyCoords=(xCoord,yCoord);
            writeMode=(useMOV,useXOR,useOR,useAND,useNOT,useNIL,useERA,useOrF);
            displayPage=(stdPage,altPage);
            whichPort=(scrPort,txtPort,curPort);
            fontType=(font8,font16);{small font for graph labels, etc.}
            screenXy=ARRAY[xyCoords] OF integer;
            point=RECORD v,h:integer END;
            box=RECORD left,top,right,bottom:integer END;
            vpRecord=RECORD
                    vpBox:box;
                    cursor,framePixels:screenXy
            END;
            colorType=0..maxColors;
            writeRecord=RECORD {record of string formatted on multiple lines}
                    xLoc:ARRAY[0..1] OF integer;
                    chPos:ARRAY[1..3] OF integer;
                    yTop,xMax,sLen:integer;
            END;
    {Type to provide uniform high speed access to system files}
            fileType=(fileString,fileFont,filePrA,filePrB,filePrC,filePrD,filePrE,filePrF,fileScreen);
    {Type to record user's preferences, hardware and current status:}
            userRecord=RECORD {fields vary from platform to platform}
                    foreGrColor,backGrColor:colorType;
                    problemNumber,graphDriver,graphMode:integer;
                    soundOn,monoOnly,foreIsBack,hasAltGraphPage,hasPalette:boolean;
                    palette:paletteType;
                    pauseLevel:0..maxPauseLevel;
            END;
    {Types used to define help menu:}
            helpType=(mathHelp,typeHelp);
            helpSet=SET OF helpType;
VAR
            hasMouse,mouseVisible,colorChgRequest,exitRequest,okControl:boolean;
            scrMaxX,scrMaxY,topScreen,scrollSpeed:integer;
            curVport:vpRecord;
            user:userRecord;
            curPage:displayPage;
            matrixMin,charSize,charSpacing,scrBorder,fontFactor:screenXy;
            wRecLast:writeRecord; {record of last string formatted on multiple lines}
            menuBox:ARRAY[helpType] OF box;
```

```
{Graphics routines; all screen output done via next 3 routines:}
PROCEDURE writeString(VAR x,y:integer;f:fontType;m:writeMode;s:stringStd);
PROCEDURE drawALine(x,y,x1,y1,width:integer;foreC,dotted,xorMode:boolean);
PROCEDURE fillScrColor(useColor:colorType); {fills current viewport}
PROCEDURE cursorInit(initYalso:boolean;frPix:integer;VAR vpRec:vpRecord);
PROCEDURE home(full:boolean); {clears full or current screen; inititializes cursor}
PROCEDURE homeBackPage; {clears alternate screen stored in memory}
PROCEDURE choosePage(page:displayPage); {displays desired screen}
PROCEDURE complCursor(x,y:integer;useCursor,flash:boolean);
PROCEDURE flashCursor(xr,yr:integer;wMode:writeMode;cursorStr:string1);

{ViewPort routines for pop-up menus, dialogues, flashing cursor, etc.:}
PROCEDURE openViewPort(xa,ya,xb,yb:integer;rp:whichPort);
PROCEDURE inframeOpenViewport;
PROCEDURE reOpenViewPort(oldCursorFrame:boolean;vP:vpRecord);
PROCEDURE clearViewPort(xa,ya,xb,yb:integer;flash:boolean);
PROCEDURE getVpRecord(port:whichPort;VAR vpRec:vpRecord);
PROCEDURE flashViewPort(count,csPause:integer);
PROCEDURE frameViewPort(layers,frPix:integer;useForeColor:boolean);
PROCEDURE fillViewPort(useForeColor:boolean);
PROCEDURE scrollViewPort(distance,jumpSize:integer);
PROCEDURE saveViewPort;
PROCEDURE restoreViewPort;
PROCEDURE closeViewPort;

{Keyboard routines; permit uniform handling of all keyboards by all compilers:}
FUNCTION keyOrMousePressed:boolean;
PROCEDURE clearKeyboard;
FUNCTIONflashRead(x,y,maxCt,flashCs:integer;quitIfKey:boolean;cursorStr:string1;VAR prefix,mouseStill:boolean):char;
FUNCTION substChar(prefix,upperC,lowerC:boolean;ch:char):char;
FUNCTION upperCase(ch:char):char;
FUNCTION lowerCase(ch:char):char;

{High speed system file input}
FUNCTION findStrings(fT:fileType;line0,line1:integer;VAR sL):integer;

{Uuniform memory management procedures for all compilers:}
FUNCTION getMem(VAR p:pointr;size:word):boolean;
PROCEDURE releaseMem(VAR p:pointr;size:word);

{Miscellaneous routines; to reconcile differences among compilers/hardware:}
PROCEDURE beep;
PROCEDURE pause(cSeconds:integer;quitIfKey:boolean);
PROCEDURE saveUserData; {saves user:userRecord to disk or network}
FUNCTION randValue(min,max:integer):integer;
PROCEDURE mouseInit; {no action on systems without a mouse}
FUNCTION button:boolean; {always false if no mouse}
FUNCTION inBox(bx:box):boolean; {mouse in given box; false if no mouse}
FUNCTION lowioInit:boolean; {false if initialization error}
PROCEDURE lowIoClose; {restore system to initial state}
FUNCTION scanEqual(lim,targ:integer;VAR source;offset:integer):integer;
FUNCTION scanNotEqual(lim,targ:integer;VAR source;offset:integer):integer;
PROCEDURE moveLeft(VAR source,dest;size:word);
PROCEDURE moveRight(VAR source,dest;size:word);
FUNCTION posChar(ch:char;s:string):integer;
PROCEDURE fillChar(VAR source;size:integer;ch:char);
```

Paper (M4-06)
New Directions for New Directors of Instructional Technology

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Abstract

School districts across the nation are beginning to employ administrators to direct their instructional technology programs. These new administrators may be hired with titles such as coordinator, director, or supervisor. These new administrators face issues that extend beyond the purchasing of hardware and software, beyond the training of teachers, beyond the writing of computer curriculum, and beyond the development of a district plan for technology. Additional issues include the diversity of current hardware and software, the scarcity of trained teachers in technology, the integration of computer curriculum into the core subjects, and the coordination of site-based plans for technology.

This paper will describe the coordinated efforts of empowered teachers in visionary teams to address many of these issues. The efforts of technology teams in San Angelo Independent School District, San Angelo, Texas, a district of over 17,000 students, has been instrumental in creating a viable plan for instructional technology.

Introduction

School districts across the country are beginning to employ administrators to direct their instructional technology programs. In February, 1990, the Texas Computer Education Association created a new special interest group for all computer coordinators/ directors. Some districts have added an additional conference period with increased job responsibilities for a teacher to direct this effort while other districts have employed coordinators, directors, or supervisors. Although the titles are slightly different, most of these administrators have the same job responsibilities. These responsibilities may include the following:

- To assist in the development and implementation of a comprehensive plan for the use of in instructional technology
- To infuse computer literacy into subject areas and grade levels
- To design curriculum guides for the purpose of defining areas of study that include timed sequence of instruction, relate items to the required textbooks, and identify additional instructional activities and resources to ensure continuity and consistency of student instruction
- To assist in the evaluation, acquisition, utilization and maintenance of computer software and hardware
- To recommend new programs and improvements to existing programs
- To assist in the planning and development of computer facilities and in the preparation of budgets and management resources
- To develop training and staff development programs relevant to the assigned areas of responsibility
- To assist in the accumulation, maintenance and dissemination of operational information and statistical data concerning the District's computer program
- To assist in the selection and evaluation of the instructional technology staff
- To provide consultant services (technical and instructional) to departments and campuses that indicate a need to develop instructional technology applications
- To serve as liaison between the District and vendors for technical instructional programs
- To assist in the development and selection of instructional technology bids
- To research periodicals and trade journals to identify commercially available hardware, software, and curriculum
- To consider membership in appropriate professional organizations
- To perform all other duties as assigned by the Assistant Superintendent of Instruction.

This list is a compilation of job descriptions offered by other school districts in Texas and conversations with individuals directly related to the area of instructional technology supervision. The districts surveyed indicate that many needs and responsibilities are similar, although some responsibilities may be written to specifically meet the individual needs of a particular district. Technology administrators face issues that extend beyond the purchasing of hardware and software, beyond the training of teachers, beyond the writing of computer curriculum, and beyond the development of a district plan for technology. Additional issues include the diversity of current hardware and software (Bruder, 1991), the scarcity of trained teachers in technology (Bruder, 1991), the integration of computer curriculum into the core subjects (Merron, 1991), and the coordination of site-based plans for technology (Kinneman, 1991). In order to address these issues, San Angelo Independent School District, San Angelo, Texas, a district of over 17,000 students, hired a Director of Instructional Technology in January, 1991. In order to identify baseline data for the district, a Vision Committee for Technology was established with at least one member from every campus (28 campuses) in the district. This committee met during the first week of February and identified a vision for technology to be accomplished by 1996 for San Angelo ISD. This vision's primary focus included the accessibility of computers for every student and for every teacher on every campus. It included telecommunications at the secondary level, writing labs at the elementary level, multimedia pilot projects on every campus, and adequate teacher training in the area of instructional technology.

The Director of Instructional Technology also purchased at least one computer for each campus, to be located in the teacher's workroom. These computers contained a popular wordprocessing package, a spreadsheet package, a grade book program, and a number of public domain programs including games, genealogy, and graphics.

The members of the Vision Committee for Technology were invited to submit a travel request to the state computer conference in Corpus Christi, Texas. Eighteen members of the committee attended this conference in June, 1990, and returned to San Angelo with ideas and/or materials to present a technology-related inservice topic to teachers at their campus.

This Vision Committee for Technology was then subdivided into four major subcommittees: District Planning Committee, Contests Committee, Endowment Committee, and the Summer Inservice Committee. The District Planning Committee continued to meet with members of the community, the superintendent, one school board member, and students to develop the 1991-1992 District Plan for Technology. The primary data used by this subcommittee was the five-year vision for technology created by the Vision Committee for Technology. Additional data was collected by questionnaire which was sent to each vision committee person to identify current hardware and software at the campus and to poll the staff regarding summer inservice needs. It was determined that current hardware was not uniform by campus and therefore not uniform by district, that no current district or campus software catalogs were available, and that summer inservice needs included basic computer literacy, wordprocessing, utilities, and instruction software integration. Three primary goals were identified:

- Increase the number of computers at the elementary level, and increase the time the students use the computers to 1.3 hours per week.
- Develop inservice programs to address the teachers needs: Introduction to the Microcomputer, Wordprocessing, Utilities, Administration and Use of Computers, and Software in the Classroom.
- Improve writing scores at all grade levels using technology.

Additional hardware will be purchased for the next three years to establish writing labs at the elementary level to teach process writing. This first effort using writing labs allows all teachers to use one wordprocessing program for one type of computer to teach process writing. Teachers, rather than lab managers, will augment the language arts curriculum with process writing on a microcomputer.

Another committee, the Computer Redeployment Committee was established to relocate computers to variouscampuses so that each campus would have the same type of computer and the same wordprocessing software. As labs were established at most of the elementary campuses, the Director held inservice training regarding the use of the lab, the use of the wordprocessing software, and keyboarding, a mandate of the Texas Education Agency.

A software inventory was developed and a software catalog was created for use in the district. This catalog can be used to identify other campuses which may have evaluated software which now being considered for purchase. Teachers using the same software packages can also coordinate their efforts and establish a network for using the software.

The Contest Committee, another subcommittee of the Vision Committee for Technology, was established to promote contests at each level. High school computer math teams will participate in a programming contest sponsored through TCEA (Texas Computer Education Association) in February, computer literacy classes at the junior high will participate in a computer literacy contest sponsored through TCEA in November, and elementary students will participate in a keyboarding contest in March at the district level. In 1992, the elementary keyboarding contest will be expanded to include creative writing.

An Endowment Committee, another subcommittee of the Vision Committee for Technology, was established to encourage visionary teachers in the use of technology. A total of $5000 was designated for this purpose. The committee requested applications for these funds without specific restrictions. The committee wanted to identify pilot innovative projects to encourage the use of technology in the district. Forty-one applications were submitted and fifteen teachers (eleven projects) were given monies for their projects. These projects were then evaluated by members of the subcommittee in November, 1991, and March, 1992. One of the more innovative projects was a biofeedback software program for emotionally disturbed students. Other projects included a color printer, a camcorder to use with multimedia, software packages, and travel expenses to a state computer conference.

The Summer Inservice Committee, the final subcommittee of the Vision Committee for Technology, responded to the questionnaires completed by vision contact persons for the district planning committee and decided to offer thirty workshops for teachers during the summer of 1991. Two of these workshops, *Maintenance for the IBM* and *Maintenance for the Apple*, were recommended for Vision Committee members in order to further train these teachers about the hardware on their campus. The response by teachers across the district who registered for workshops was overwhelming, and an additional four workshops were created: *Introduction to the IBM* (three workshops) and *IBM Utilities: Wordprocessing and Gradebooks* (one workshop).

A network of computer advocates, members of the Vision Committee for Technology, now exists in San Angelo I.S.D. These computer advocates garner support for technology at their campuses and act as a liaison between the teachers and the Director of Technology. Although there is an emphasis on writing at the elementary level and telecommunications at the secondary level, the Endowment Fund has offered teachers a process for creating innovative projects across the district, projects that may become district-wide efforts. The coordinated efforts of empowered teachers in visionary teams have addressed numerous issues in San Angelo I.S.D. Without these efforts, a technology program envisioned in January, 1991, by the San Angelo Independent School District Superintendent and School Board would not have matured to a sophisticated and viable technology program.

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Special Presentation–ACM/SIGUCCS (M4-07)
Computing Services for Students with Disabilities

Sheryl Burgstahler
University of Washington
Seattle, Washington

James Kerlin
Pennsylvania State University
University Park, Pennsylvania

Abstract

Federal legislation is generally interpreted to mean that colleges and universities are required to provide students with disabilities access to computing equipment when such access is required for academic studies. This presentation will outline the legislative framework in this area, summarize various approaches to providing computing access to individuals with specific disabilities, give examples of the computing services that campuses can provide to students with disabilities and provide examples of resources that are currently available at some campuses.

Projects (M4-08)
Technology-Supported Writing

Educational Restructuring Model: Windows to the Future—Language Arts/Technology/Careers

Bronwyn Rhoades
Mendocino High School
Mendocino, California

Larry Martin
Regional Occupational Program
Mendocino, California

Abstract

This project presentation documents how ten teachers, two administrators, one district librarian and one career technician came together to build a model for restructuring high school education through technology. Our vision is based on the belief that teachers need to honor a wider variety of learning styles, motivate the at-risk, and empower all students to be constructors of their own learning. Technology is the key.

The *Windows to the Future* model has developed in five stages. Stage one was developing a shared vision that would comfortably and naturally blend audio, video, computer, and multi-media technology skills with academic language arts skills. The second stage was the pooling and allocating of resources, teaching staffs, hardware, software and facilities. The third stage was drafting the curriculum during a summer curriculum writing workshop. The fourth stage was and continues to be prototyping phase I. The fifth stage is utilizing authentic assessment tools to assess both teaching and learning outcomes.

We will offer a brief summary of the first phase of the integrated model, Windows I, with highlights of our successes, an articulation of the problems, and the strategies that we have followed to encourage teacher, student, parent and community participation.

Practical Brainstorming & Writing Projects for One-Computer Classrooms

Annette Lamb
University of Ohio
Toledo, Ohio

Abstract

Not everyone has access to the newest technology. Some educators need practical ideas to get them started using the equipment they have. Others have the latest technology and have jumped on the "high tech" bandwagon, but may have forgotten some of the simple and effective applications they learned as beginners. This session focuses on practical ideas for a one-computer classroom.

First, the session focuses on equipment access. Where can you get a computer if you don't have one full time? Do you need the very best computer? What can you do with an old Apple IIE? What's an LCD projector and how does it work? How can you enlarge the image if you don't have an LCD?

Second, the session discusses simple, practical projects for using a computer in large group instruction including ideas for brainstorming, report writing, chainwriting, large group journals, and other writing projects. Projects range from simple sentence regrouping lessons to peer editing. In addition, classroom management ideas for using the computer as a learning center in conjunction with large group activities will be discussed.

Third, the session focuses on ideas for integrating the computer into educator committee work such as accreditation paperwork and curriculum committees. Group brainstorming and report writing projects are discussed in addition to the logistics of leading a group using a single computer.

Fourth, the session focuses on a variety of software that can be used for this type of application including word processing, desktop publishing, spreadsheets, databases, and hypermedia.

Writing Across the Curriculum—Realia and Writing

Heidi Imhof
Yukon Koyukuk School District
Nenane, Alaska

Abstract

This session will briefly overview the *Alaska Writing Program (AWP)*, a computer-prompted writing environment based on the process approach to writing popularized by the Bay Area Writing Project. The *AWP* is a Title VII Academic Excellence program currently being disseminated through a three-day workshop model to school districts in the Western states.

As our training team grew more experienced with the *AWP* at actual school sites and dissemination workshops, we dramatically restructured our training approach. Originally, our workshops leaned toward the theoretical base for process writing and demonstrated the technological tool, the *AWP*, that integrated theory with hands-on computer assisted writing. Now, the project has embraced a training philosophy that creates learning environments through the use of realia kits—real things, experiences and information sources selected to excite the curiosity of even the most reluctant writer/learner. Our workshop focus has shifted to thinking and writing in content areas. The realia kits are purposefully cross-curricular, and the writing activities used with them are designed both to clarify thinking and to communicate understanding. Handouts will include annotated reference lists for the realia kits shown in the session. .

Projects (M4-09)
Media Tools for Special Needs Students

Special Projects for High School Special Education Resource Students
Mimi Suttles
Austin, Texas

Abstract

Abstract not available at press time

Technology Tools for Advancing Literacy Learning in Special Populations
J.D. Steelman
Chapel Hill, North Carolina

Abstract

Abstract not available at press time

Appropriate Software for the Moderately Mentally Handicapped
Tracy Ray
Dallas Texas

Abstract

This Session focuses on developmentally appropriate software for handicapped students Pre-K through High School. Specific programs will be discussed and reviewed which enhance readiness, language arts, math and Daily Living Skills in the different classroom settings. Moderate to mild mental handicaps will be covered. Handouts will be provided with the names and categories of programs disscussed as well as additonal programs that have been tried in Dallas ISD classrooms and have proven to be successful.

Interactive Video in Special Education PR-2
Cynthia Jamieson, Peggy Remis
The Regional Consortium for Education and Technology
Chesterfield, Missouri

Abstract

Often special educators don't utilize the interactive video technology available in their schools. There are few videodiscs available that are tailored for the needs of these educators and their students. Participants in this presentation will see how a number of educators have overcome this roadblock by designing creative lessons using existing UNRELATED videodiscs. The key to creative usage is to establish objectives first and then view each disc as a database of independent images that meet those objectives. Examples shown will be lessons in appropriate behavior, social skills, language and writing taught in the context of a history lesson.

Projects (M4-10)
Teacher Tools

HyperCard: A Creative Alternative for Student Presentations

Jan Johnson
Karnes City High School
Karnes, Texas

Abstract

Animation, sound, graphics, and audience interaction make HyperCard stacks an exciting alternative to the traditional oral or written report.These "stacks" are a type of computer program, written on a Macintosh computer with the help of an inexpensive software authoring program. The program is easy to use, even for those with no prior programming experience.

Stacks have many advantages over traditional reports. To create a stack, students must also research a topic and write, but in addition they must use critical thinking skills (as they structure their stack) and creative skills (as they add art, sound and animation to enhance their multimedia presentation).

An added bonus is that their work lives on from year to year, and has a much wider audience than before. Stacks may be enhanced by next year's class, combined with others on the same topic to create a useful teaching tool, or exchanged with those written by students across the country.

In this presentation, student-written stacks will be shared, as well as suggestions about how to implement this project in different school environments and on platforms other than Macintosh.

Enhancing Integration of Computers through Productivity Applications

David Byrum
South West Texas State University
San Marcos, Texas

Cyndy Cashman
University of Oklahoma
Norman, Oklahoma

Abstract

One of the most talked about subjects in educational computing is the integration of computers into the classroom curriculum. An emerging but often overlooked method is the use of productivity applications and teacher or student produced instructional activities. By using programs as Appleworks or Microsoft Works, teachers are able to enhance their classroom instruction as well as give students valuable computer experiences in data manipulation skills required in word processing, databases, and spreadsheets. Productivity tools offer several advantages in curriculum integration: 1) tool software is not tied to any specific content or subject matter and can be used across the curriculum, 2) activities can be produced locally to meet specific objectives, 3) tool software is usually available at all locations, 4) activities can be developed either by the teacher or students lending itself well to cooperative teaching methods, 5) can be used in both individual or group settings, and 6) students learn real-life skills which can be used later in the work world thus deflecting much criticism that computers are not used in real-life situations. Our current project is the development of teaching materials for pre and inservice teachers in how to use productivity tools to develop instructional activities for the classroom.

HyperTestMaker: A HyperCard Stack for Preparing and Giving Tests

Michael Land
Midwestern State University
Wichita Falls, Texas

Abstract

The presenters will describe and demonstrate the use of *HyperTestMaker*. *HyperTestMaker* is a stack that allows the user to import text files and place the contents into a multiple-choice or alternate-choice format. If the answers to the questions are in the text file, then the stack will accept the answers but hide them from the student. Otherwise, the instructor can insert the answers manually. Other features of *HyperTestMaker*, that the instructor can select, include the ability to change the style of the question and the answer fields, save a file of the responses, flash the correct answer when it is selected, give up to five tries per question, and give partial credit for correct responses after a miss. Although the stack is copyrighted, individuals who bring a 3.5 inch disk may have a copy of the stack to use in their own classrooms.

Using AppleWorks in the Classroom

Jamesetta Seals
Houston, Texas

Abstract

Abstract not available at press time

Projects (M4-11)
Texas Center for Educational Technology

Educational Technology Research and Development: What Works in Texas

Ken Brumbaugh
University of North Texas
Denton, Texas

Abstract

The Texas Center for Educational Technology (TCET) is a research and development consortium whose mission is to improve K-12 education through technology. TCET serves school districts, the Texas Education Agency, universities, businesses and other groups that use, develop, and distribute educational technology.

TCET research, development and dissemination work emphasizes 3 areas:

- improving the use of existing technology in schools,
- helping implement corporate and industrial technologies into schools, and
- designing new technologies for use in schools.

The faculty-directed research activities and projects at the University of North Texas, The University of Texas at Austin, and University of Houston-Clear Lake have positively affected technology-based learning and teaching in Texas through their research in teacher education support, student learning, and educational systems.

The results accomplished in Year One by TCET generally fall into four categories: Contracts Obtained, Contributions Received, Products Produced, and Educators Benefited. In its first year TCET received various contracts totaling just over $700,000 and contributions from businesses totaling nearly $500,000. These contracts for services, contributions, and donations allow TCET to keep its membership fees to individuals and school districts quite low. TCET has been accepting memberships since April, 1991, in 5 categories: Individual, District, Associate, Partnership, and Sustaining members. Membership is now over 400, and about a third of all Texas school districts are members. A new Governing Board was approved in August. Chosen from among TCET membership, board members represent public schools, sponsoring universities, and business supporters.

The main TCET activities/projects most visible to teachers have been the Technology Excellence (TEX) Contest, the Summer Institutes at UNT and UT-Austin, and products now available for sale to members. The TEX Contest had nearly 60 entries and awarded 11 cash prizes and 13 honorable mention certificates. Summaries of the entries and Application Pamphlets on selected projects are made available to members. The Summer Institutes at both TCET sites offered teacher training in technology plus stipends to defray the expenses of attending. TCET's latest Member Catalog of Products now features 42 products in a variety of categories: booklets, software, videotapes, pamphlets, and annotated bibliographies. Other dissemination activities include a quarterly newsletter, the *Tex-CET Times*, TCET updates in the TCEA *Tech-Edge* magazine, and presentations at a wide variety of conferences (51 made in 1990-91).

For 1991-92, TCET is continuing a variety of research and development activities and projects at its three sites. Details on each location will be presented in sessions immediately following this one.

What Do Integrated Learning Systems, School Consulting, and Telecommunications All Have in Common?

Kathleen Holmes
University of North Texas
Denton, Texas

Abstract

Research activities at UNT focus on four broad categories, all in the K-12 educational area. The four projects being conducted by faculty at UNT are as follows: Curriculum and Instruction, Instructional Design and Evaluation, Student Learning and Special Populations, and Telecommunications and Informatics.

The Curriculum and Instruction research activity concentrates on using technology in curricula areas and improving teaching through effectively using technology. Current efforts include evaluating integrated learning systems, studying technology applications for special needs

school districts in the task of selecting and later evaluating the effectiveness of this popular technology. This kit should become available to Texas administrators and teachers toward the middle of Spring semester, 1992. Students in several school districts, including Dallas ISD, and students, and problem solving with technology. An assessment and evaluation kit for integrated learning systems has been developed to assist school districts in the task of selecting and later evaluating the effectiveness of this popular technology. This kit should become available to young adults in the Texas State School system, are being assisted through curriculum and instruction research projects.

Schools throughout the state and country are in need of "cookbook" approaches to evaluating technology in education. It is hoped that the consulting packages will fill a support void now evident in education. Development activities as a part of this project include creating video tapes of model school districts who have successfully implemented educational technology applications.

Special populations are specifically served by activities in the Student Learning and Special Populations research project. This year efforts will be concentrated on studying applications of technology for the handicapped. It is hoped that TCET will become a showcase for technological solutions in this tremendously important development area. With the addition of new staff having expertise in deaf education, avenues are being explored for ways in which TCET research and development can be targeted at this particular special population.

The Telecommunications and Informatics research project concentrates on distance learning, electronically connecting educators, and multilingual education through technology. Efforts are now underway to develop an electronic information retrieval system offering K-12 technology-using educators fingertip access to databases uniquely designed for their classroom needs. Connecting rural school districts via a fiber optics-based network is also under study.

Better Technology Training for Pre-Service Teachers, and Teacher-Designed Software

George Culp
The University of Texas at Austin
Austin, Texas

Abstract

Two major projects are continuing at UT-Austin under the direction of Dr. George Culp and Dr. DeLayne Hudspeth. Culp's group is working on collaborative software development, while Hudspeth's efforts focus on research, development, and dissemination regarding technology training for pre-service teachers.

Collaborative software development involves teachers and administrators from Valley View and Highland Park elementary schools, and faculty and staff from the College of Education at UT-Austin. The public school teachers work with UT faculty and graduate research assistants to design and develop HyperCard stacks that will meet specific needs defined by the teachers.

The teachers provide the content for the stacks as well as a general design for the sequence of information. Each stack includes documentation which provides information on the curriculum area, the targeted audience, purpose of the stack, educational objectives, instructions for use, and references/resources.

Given the teachers' content and design, the research assistants develop the text layout, information sequencing links, graphics, animation, and/or music to present the information to students in an interesting and informative way. The develop-ment team then pilot tests the stacks and collaborates on needed revisions. This research project expects to complete at least six HyperCard stacks, including 4 that incorporate materials from Optical Data's *Windows on Science* series.

Dr. Hudspeth's project seeks to improve the skills and attitudes of new teachers toward using technology in the classroom. One goal is to create an information resource for public school administrators and teachers that will describe and identify inservice training needed to use technology in the classroom. The resource will have 1) a survey document detailing current efforts and programs used to prepare public school teachers in technology use, 2) curriculum descriptions that reflect technology skills taught to new teachers, and 3) a report on the ways and means by which teacher-training institutions prepare new teachers to use technology in the classroom.

The problem area being addressed is that each year new teachers enter the public schools without being adequately trained in the effective use of educational technology. Their inservice training needs are vague because it is unclear how much technology training has been provided for them and how much they have mastered. Accordingly, this project seeks to 1) examine and assess current efforts to prepare new teachers to use technology effectively, 2) share ideas and resources for improving the technology skills of new teachers, and 3) consider ways by which new teachers can generally become productive as soon as possible through the use of technology. With proper training, new teachers can serve as technology-use models, and possibly even as resources to other teachers.

Teaching Transferable Problem-Solving Skills: Exploring Computer Simulations, LEGO/Logo, and Hypermedia

David Palumbo
University of Houston-Clear Lake
Houston, Texas

Abstract

As we move into the age of technology, a fundamental shift in education is needed that will focus on two essential attributes: 1) the ability to successfully interact with technology, and 2) the ability to use higher-level, critical thinking skills. A good starting point would be to replace the ambiguous term "learning" with the more exact term "knowledge construction," defined as the process of assimilating and accommodating information in a way which builds explicitly upon the existing mental models that students already have.

The Advanced Knowledge Transfer (AKT) project will facilitate research into and the development of a new learning environment based on knowledge construction and transfer, with a goal of developing new insights into how we teach, think, and learn. These new instructional environments draw on the rapid advances in computer technologies and new insights into cognitive science. Two specific research activities are designed to explore these issues.

First, the project will seek to assess the impact of various computer-based technologies as related to promoting higher-order thinking skills. While education often emphasizes transferable problem-solving skills, such a transfer has been difficult to document. Research will focus on three specific computer applications associated with problem-solving: 1) computer simulations, 2) LEGO/Logo activities, and 3) the use of hypermedia.

Research into the use of these three applications will result in curriculum guides that support the use of those technologies. Centering on eight hours of instruction, each guide will be grade-level specific and provide objectives for daily lessons, relate the objectives to appropriate essential elements, and provide ideas for evaluation. A key component of each guide will be how to use the specific technology addressed.

Second, the AKT project will explore a Hypermedia-Assisted Knowledge Construction System (HAKCS). This research activity seeks to determine if user-generated explicit semantics that are presented in a hypermedia environment can promote learning in a variety of content areas. Preliminary research in this area suggests that knowledge construction can be achieved by explicitly relating and connecting various nodes of information in long-term memory. The specific research activity presents a learner with a peripheral mental model constructed in computer-generated hypermedia. The learner is then challenged to correctly construct each of the expert-defined semantic relationships that is presented. The great potential of this part of the project is that it can help determine the impact that hypermedia could have upon knowledge construction-based learning environments.

Projects (M4-12)
Science/Math K-12

WORLD-Window on Real Life Data

Robert Moore and Maurice Mitchell
University of Las Vegas, Nevada
Las Vegas, Nevada

Peggy Moore
Clark County School District
Las Vegas, Nevada

Abstract

The project focuses on providing an environment for developing research skills and "doing science." Our initiative provides the students in three elementary schools in the Clark County School District computer-mediated communications connections to other students across our nation and globe through electronic mail on BITnet and the Internet. Students are able to exchange science data (i.e., weather and astronomy) from first hand sources of information. Additionally, students will be able to ask and have answered literally hundreds of questions about geographical, cultural and socio-political events; truly a Window On Real Life Data.

Reach for the Stars: Improving Science Education in the Middle Grades

Cecilia Lenk
Massachusetts Corporation for Educational Telecommunications
Cambridge, Massachusetts

Abstract

The goal of the federally funded Reach for the Stars project is to improve science teaching and learning in the middle grades (grades 5-8) through an interdisciplinary approach to science education which involves multiple technologies, hands-on science activities for students, and extensive support for teachers, school and district-level administrators and content specialists, and parents. This session will demonstrate some of the innovative Reach for the Stars satellite programming and instructional products including: "Race to Save the Planet," an interactive videodisc developed by WGBH; "Space Probe 2030," an interactive videodisc developed by the Chedd-Angier Production Company and Tom Snyder Productions; and "Critical Thinking in Content Areas," a telecourse developed and presented by David Perkins, Harvard University, and Robert Swartz, University of Massachusetts. The session will also provide examples of how the Reach for the Stars programs and products are being integrated into middle level science and non-science classrooms in 60 demonstration schools throughout New England and New York.

Enhancing the Teaching of Elementary Mathematics Using Interactive Media

Mary Jane Ford
University of Southwestern Louisiana
Lafayette, Louisiana

Abstract

The use of multimedia in instruction is receiving increasing attention. It is imperative that we prepare today's teacher to utilize this technology in the classroom.

Teachers tend to teach the way in which they are taught. Therefore, if teachers are expected to use multimedia as an instructional technique it is necessary for them to experience learning through multimedia. To provide such experiences, presentations were developed in several subject areas. This project presentation details the preparation and use of a multimedia instructional presentation in the area of elementary mathematics methods for preservice and inservice teachers.

The instructional presentation was prepared using an animation package, HyperCard, and a commercial laser disc. The subject of the instructional multimedia presentation was teaching the various interpretations of multiplication and division. The animation package was used to prepare the introduction and bridges in the presentation. HyperCard was used to provide content information and to access pertinent laser disc frames. The laser disk provided content and illustrations of concepts.

ENLIST Micros III: Models for Establishing *ENLIST Micros* Teacher Centers

Philip G. Goulding, James D. Ellis
Colorado Springs, Colorado

Abstract

The Biological Sciences Curriculum Study (BSCS), with support from the National Science Foundation (NSF), is conducting the third phase of *ENLIST Micros*. Phase I developed a set of multimedia materials (video, text, instructors guide, and demonstration software). Phase II developed a staff development model (leaders and building teams attending workshops and seminars and supporting each other) for implementing microcomputers in science teaching. Since Phase III began in 1989, BSCS has established 18 teacher centers for *ENLIST Micros*. BSCS provided the staff from each of these centers with a two-week summer institute, three follow-up leadership seminars, three site visits, and consultative support via telephone and computer bulletin board. BSCS has found the *ENLIST Micros* project to be effective with teachers throughout the nation. Centers which began in 1989 are now entirely self-supporting through local or other funding. BSCS staff, with the assistance of staff at each of the centers, is gathering information to evaluate the effectiveness of the trainer-of-trainers approach to replicating *ENLIST Micros* project at regional sites. During the session, we will report evaluation results from the centers.

Projects (M4-13)
Telecommunications

Integrating Database Search Activities into the Curriculum

Anne Caputo
Catholic University of America
Washington, D.C.

Abstract

Abstract not available at press time

Telecommunicating: Teacher to Teacher

TyAnn Morehead
New Hampton Community School District
Waverly, Iowa

Patty Achey-Cutts
Area Education Agency 7
Cedar Falls, Iowa

Abstract

Twenty-five middle schools in Iowa received a grant that included the National Geographic Society's GTV laser videodisc and the equipment needed to run it. A unique component of the grant was membership in America Online, a modem, installation of a dedicated phone line, and money for long distance charges to a local access number. After receiving training at a two day workshop, teachers took the equipment back to their schools to begin a technology adventure.

Two teachers coordinated the telecommunications portion of the grant. These teachers answered questions and hosted periodic online conferences. Teachers shared ideas, lesson plans, frustrations, joys, and student work via electronic mail. The online portion of the grant provided much needed post-training support and a timely way to share ideas.

In late February, a face-to-face meeting was held to celebrate the group's successes and to trouble shoot challenges they faced. This meeting was hosted by an Area Education Agency. This project is unique in that teachers received training from national leaders, were supported in the field by two teachers via telecommunications and by their local Area Education Agency. This combination of support systems was an important factor in the success of this project.

ASCD Access Progress Report: Expanding Services to Meet Member Needs

Vicki Hancock
ASCD
Alexandria, Virginia

Abstract

Abstract not available at press time

Implementation /Evaluation of an Electronic Communication Network for New Teachers

Ann D. Thompson, Caroline Hayes
Iowa State University
Ames, Iowa

Abstract

The College of Education at Iowa State University has had an electronic network system for first year teachers and student teachers operating for more than four years. In this project description, the establishment and utilization of this electronic network system for new teachers is outlined. Procedures for establishing the system, data on the use of the system, and challenges in keeping the system active are all included. The objective of this project description is to outline evolving usage patterns of an electronic communication system designed to facilitate professional communication for new educators and to determine if this use does benefit the induction process for this group.

The results reported here provide direction for possible interventions to facilitate the use of these systems to encourage professional communications opportunities for new educators. Results suggest that new teachers were most comfortable using the system to communicate with each other. Interventions to encourage interactions with more experienced educators should be implemented and studied. It is interesting to note that the least frequent topic of communication for the new educators was specific classroom curriculum issues; one of the major reasons for creating such a network is to provide support for beginning teachers in this area, yet it seems evident that some intervention is necessary to make this topic a vital part of the system.

Special Presentation–Panel (T1-01)

Teacher Training for Information Technology: International Perspectives

Gerald Knezek, Moderator
University of North Texas
Denton, Texas

Abstract

U.S. State and local education agency initiatives for teacher training in information technology vary widely in terms of goals, funding, and implementation methods. This international panel offers examples of systematic planning, innovative on-the-job support, extracting the best from the world community for the local environment, and comparative joys and frustrations of trainers who have worked in wealthy and underdeveloped areas of the world. These examples may provide models for well-funded and not-so-well funded programs in the USA.

Panelists:

Takashi Sakamoto
Tokyo Institute of Technology
Tokyo, Japan
Japan's National Teacher Training Requirements

Jim Ridgway
Lancaster University
Lancaster, United Kingdom
UK Initiatives for Supporting Teachers Across the Curriculum

Avrille Coar
National Institute of Higher Education
Trinidad, Tobago
Initiating Teacher Training for Information Technology in the Island Nation of Trindad-Tobago

Iliana Nikolova & Rumen Nikolov
Sofia University
Sofia, Bulgaria
Training Teachers in Computer Education: A Trainer's Transnational View

Don Knezek
Region 20 Education Service Center
San Antonio, Texas
Emerging U.S. Teacher Training Standards: Texas as One Among 50

Special Window (T1-02)

Virtual Realities: From the Concrete to the Barely Imaginable

Stephen Marcus,
University of California at Santa Barbara
Santa Barbara, California

Abstract

This session deals with "deep media," demonstrating unusual (some would say offbeat) interfaces and metaphors for future educational computing. These include systems like Reality Built for Two, Virtualities, Mandala, the Alternate Reality Kit, the Virtual Environment Workstation, SemNet, and A Very Nervous System. The discussion includes attention to new Japanese software initiatives, the development of the "smart book," and the elusive RUM, DWIM, and DWIN commands.

A major concept dealt with involves "virtual realities," simulations that you seem to enter physically. If text "tells, and video and film show, then a virtual reality embodies" the world it creates (Randall Walser, Autodesk Research Lab). This leads to considerations of how to represent things that are essentially indiscernible (Warren Robinett, University of North Carolina).

This session illustrates virtual reality hardware and software and explores the educational implications of radical shifts in point of view: you can become the data, and you can function in environments in which space itself is the interface.

Our involvement with new technologies generally moves from an ambivalent relationship with augmented abilities to the "dawning of irreversible change" (Akram Midani, Carnegie-Mellon University). This presentation suggests some of the implications of virtual realities—for various subject matter areas, in adaptive technology, and on our expectations and visions for educational computing.

ADAPT Spotlight (T1-03)

Big Books to Comic Books! Whole Language Fun!

Joel Fried, President
Pelican Software
Farmington, Connecticut

Abstract

Bring your language arts classroom to life! Software programs discussed are ideal for stimulating oral and written language expression and facilitating the development of social skills. Come join the fun while learning strategies to incorporate software effectively into the whole language classroom from the primary level through high school.

Special Presentation–Panel (T1–04)

National Science Foundation Perspectives on NSFNET and NREN

Virginia Eaton, Moderator
National Science Foundation
Washington, D.C.

Abstract

Abstract not available at press time

Special Presentation–ECMI (T1-05)
Network Management, Support and Applications

Jesse Lewis and Mou-Liang Kung
Norfolk State University
Norfolk, Virginia

Nagi Wakim
NASA
Greenbelt, Maryland

Abstract

This session is designed to inform the faculty from minority institutions about campus networking, network management, network support, and network applications. The services and research opportunities provided by MU-SPIN (Minority University-Space Interdisciplinary Network) will be discussed, and information on how to install your own local area network by using a "Networking Starter's Kit" will be provided.

MU-SPIN is a comprehensive education initiative that is oriented around wide area networking technology and its use for supporting multi-disciplinary scientific research. It is aimed at transferring advanced computer networking technology to the under-represented academic community.

Projects (T1-06)
Middle and High School Mathematics

Using Computer-Intensive Resampling Techniques to Teach Statistics

Peter Bruce
Director, Resampling Project
Arlington, Virginia

Abstract

Probability and statistics are of fundamental importance to citizens and workers in an increasingly information-based world. While significant strides have been made in the teaching of descriptive statistics, the teaching of probability and inference remains a problem. The subject as it is conventionally taught, using parametric methods based on the Gaussian distribution, is inherently difficult because of the need to learn formulae which a hundred years of experience show cannot be taught in a fashion that is intuitively obvious to most potential users.

The resampling method provides a safe passage through the horns of this dilemma. Its probabilistic tools—coin flipping, card picking and their computer equivalents—are fully satisfactory both theoretically and practically, and present no great difficulty in learning. Indeed, the learning process is sufficiently enjoyable that people develop a positive attitude towards the subject.

Moreover, resampling simulation also provides a far more natural bridge between data-driven exploration of statistical concepts and the probabilistic and statistical inference extension of those ideas than does the conventional method.

The use of resampling in the classroom has been tested. Controlled experiments showed that students solved more problems in less time with resampling than with conventional techniques. They also found the resampling method more enjoyable.

Middle School Math–A Cooperative Venture

Leroy Tuscher and Sandra Becker
Reading, Pennsylvania

Abstract

Research associates in the Educational Technology Program at Lehigh University, mathematics teachers in the Haverford Middle School, and students from Haverford worked cooperatively to produce a middle school mathematics interactive digital video application. An excerpt from the project will be shown. The Haverford teachers were actively involved from the inception of the project. Video scripts were written to enhance motivation and to promote interactive learning so that middle school youngsters could demonstrate and teach their peers the uses of math. The video segments were shot on site in the baseball field, in the local mall, and in the gymnasium. Real-life problems were developed by one of the associates. Haverford teachers were involved in the stages of development during inservice opportunities. The project involves digital video segments, instructional segments, and elements of intelligent tutoring including hypermedia.

Logo Explorations for Middle School Mathematics Classes

Eadie Adamson
The Dalton School
New York, New York

Abstract

Computer use in the context of a math class makes sense when its incorporation adds a meaningful dimension to the class work. A group of teachers at Dalton preferred not to use "educational" games in conjunction with mathematics. Instead we searched out ways to use Logo to extend thinking. We have been integrating LogoWriter and Lego Logo into their math classes, using activities designed either to introduce a new concept, to provide another method for displaying knowledge they have already acquired, or to serve as an extension or culmination of classroom activities. One gifted math student in the fourth grade has spent his math time in a special tutorial working exclusively with Logo. A series of activities developed during the course of the year will be demonstrated.

The Word Problem Problem

John C. Miller
The City College of CUNY
New York, New York

Abstract

Word problems confound even students who master most of elementary algebra. Algebraic operations must now relate to domains outside pure mathematics. Constructing a suitable equation requires many steps, most not consequences of the preceding steps.

Students learn to solve word problems, if at all, by solving word problems. Abstract problem solving strategies are unproductive because they require students to move from the abstract toward the concrete. Most understanding is acquired by proceeding from the concrete toward the abstract.

This project asks students to solve word problems and helps them at every step. Help includes sample problems with complete solutions, hints on request, a complete next step whenever needed, and dialogues to suggest needed relationships.

Students type step-by-step solutions and edit their input by mouse or by commands from pop-up menus. The program accepts alternate forms of algebraic expressions, assesses verbal entries using artificial intelligence techniques, and alters its problem solving strategy to match the current student's apparent strategy.

A preliminary report on the success of this project will conclude the presentation.

Paper (T1-07)

The ScanPort Reader: A Computing Program for On-Line Diagnosis of Reading Performance

Robert P. O'Reilly, Dave Brown, and Ruth Caswell
Morgan, Texas

Abstract

This report presents a description of the ScanPort Reader, a moving window adaptation of the expensive and personnel-intensive laboratory techniques currently used in eye movement research in reading. Eye movement tracking devices have been a major factor in recent theoretical breakthroughs in reading. Eye movement studies have shown that proficient readers densely fixate the words in a text as opposed to current views of reading which emphasize minimal sampling of the text. The moving window format provides a method for adapting this complex technology to the diagnostic needs of the reading teacher, using a program written in C++ for the IBM PC. The SPR provides an on-line analysis of the word-by-word performance form a large date base of sample passages.

The SPR consists of several programs which, together, record the readers word-time date, present the passages to the reader in a variable size moving window frame, allow for the entry of new passages, and provide for analysis of the word time data. The passages are encoded to facilitate analysis of problems with information processing underlying the reader's performance. For example, word time patterns of key words, phrases, and clauses allow for determination of the size of the text unit that readers habitually encode as they process a text. The analytical framework used offers teachers a wholly new approach to the detection of reading problems—one that provides for a much more fine-grained evaluation than paper-and-pencil testing.

The SPR enables users to vary several factors which can affect how well the program matches the reader's strategies and the cognitive demands of the reading task. The resultant word-time date are extremely sensitive to the linguistic attributes of the text and the reader's ongoing strategies in attempting to apprehend its meaning. Even when the viewing port is limited to exposing a single word at a time, readers appear to adjust to the procedure and approximate their normal reading rates. Thus the SPR appears to be an ecologically valid method for obtaining on-line data on reading performance in the context of the ordinary classroom.

The program is easy to use, low cost, and offers the reading teacher and specialist a major new tool for diagnosing reading problems. The data reveal the reader's natural strategies for processing a text as they occur, rather than requiring the analyst to make inferences from answers to questions when reading has already terminated.

This report describes the program in detail, provides examples of the data it generates, and shows how the data may be used to more precisely define the nature of individual reading problems. The SPR provides a truly effective computer application in the analysis of reading performance, as opposed to using it ass simply another platform for paper-and pencil testing.

The ScanPort Reader

The past 15 years has been truly exceptional in terms of what we have learned about the reading process. Much of our new understanding has arisen from the work of cognitive psychologists working in the fields of reading, memory, information processing, and artificial intelligence. Earlier research relating to reading has emphasized the analysis of reading outcomes such as comprehension skills. Much of this new work, however, has focused on behaviors that can be directly observed during the act of reading. As a result, we now have a better and more detailed understanding of the component processes involved in reading and of how they are executed and coordinated as the reader processes a line of text.

Earlier views of the reading process suggested that fluent readers were good because they used their language skills and knowledge to guess the upcoming words in the text. Their advantage in speed and comprehension, it was thought, came about because they only had to minimally sample the text to confirm their guesses. Numerous experimental studies of the reading process now show us that this view is no longer tenable. For example, data from eye movement studies have shown that readers densely sample the text: They fixate on about 85% of the content words in the text and a sizeable proportion of the function words. Moreover, these studies show that the time readers spend on various linguistic units in a text, such as words, phrases, clauses, and sentences are reliable indicators of the integrative processes that occur during reading.

Thus the duration of time that readers spend on various linguistic units in a text provides a revealing window into their underlying strategies, as they attempt to grasp the meaning of a text. The time readers spend on the individual words in a text constitutes one of the few observable reading behaviors that can be measured on-line.

Usually thought to be primarily an indicator of the cognitive processes that underlie reading, the times spent reading individual words may be used to infer cognitive structures as well. Until recently, however, the costs, manpower, and technical requirements of the devices used to track reading times on words prohibited their practical application in the classroom. Now, with the moving window paradigm, the eye movement tracking device can be closely approximated, at low cost, in the normal classroom environment. The platform for the moving window is an inexpensive personal computer, programmed to present the words in a text in a reader controlled format.

The focus of this discussion is a description of a PC based moving window program specially designed for use by teachers—the Scanport Reader. The SPR is primarily intended at this time as an aid to the analysis of the reading skill of students in grades one through college. Since the technique is so new to the classroom, this discussion addresses several topics necessary to an understanding and appreciation of how it may be used to facilitate: (1) reading assessment; (2) reading instruction; and (3) administration of the school reading program. We begin by outlining the design of the display for the SPR and how it is packaged for use in the classroom by students and teachers. We then provide several examples of how reading times for the words in a text provide a reliable sensitive, and valid indicator of the reader's responses to the linguistic attributes of a text. We discuss the rationale for the word-by-word reading paradigm, its underlying assumptions, and its cost and comparability to other valid methods used for collecting reading time data. Finally, we show how reading time data can be encoded and indexed to reflect the reader' attempt to construct a coherent representation of a text.

The SPR, an example of the moving window technology under development, is an advanced and flexible format for presenting the information in a text in a controlled but user-friendly format. In a sense, the SPR provides roughly the kinds of data that are often attributable to the informal reading inventory. The IRI is the only other on-line reading measure commonly available to the classroom teacher. In its xal format, for example, the trained user is able to follow the reader's oral rendition of the text on a word-by-word basis. But tracking and scoring all of the variables signaled in the reader's oral record is a herculean task—far more than anyone could hope to do. The SPR, however, does just that: It provides a measure of reading time for every feature encoded in its test passages. These indices encompass much more than the individual words. They can be used, for example, to signal the reader's encounters with the syntactic structure of the text. In addition, as will be seen, they can tell us much about the reader's success in building a mental representation of the text.

The Display

Our reader sits before a PC where the monitor displays a "page" of text in Greeked, barely perceptible, gray letters on light gray "paper". With the exception of the punctuation, which appears in normal contrast, the actual letters of the text have been converted to nearly imperceptible Greek letters. Altogether, the Greeked letters and words, and the punctuation give the impression of a normal text. This configuration of words, word spaces, and clause and sentence boundaries provides a nonintrusive but necessary background for the window. When ready, the reader presses the forward key (>) and the underlying text is exposed in normal characters, a word at a time, in high contrast (black letters on a white background). With each forward key press the ScanPort progresses instantly over the words in each line of text, giving the impression of a moving window—where the currently fixated word is the only word clearly in view.

When the reader wishes to return to a previously viewed word in the text, that is, regress as readers do about 10-15% of the time, he presses the reverse key (<). Now, the ScanPort proceeds under the reader's control backward through the text, again for each key press a word at a time. (Typically, most regression encompass only one word or 4-6 character spaces). A press of the forward key then returns the reader to the last word viewed in the text and reading again proceeds normally. Following a short period of practice with the trial passages, the reader quickly learns how to rapidly shift back and forth between prior text and the last word in view.

The ScanPort is a variable length "window" which may be set to control the units of information the reader will see at each key press. This unit of information is normally a single word but may be adjusted to include larger units of text. Though the reader ordinarily fixates on one word at a time during normal reading, the eyes in a sense also "see ahead" of the current point of regard to determine where to land next. This information, which is only vaguely perceived in peripheral vision, extends out to about 15 characters from the current point of regard. To simulate this additional information, the characters preceding and trailing the current word are displayed in low contrast.

The use of Greeked text along with the normal but low contrast characters around the point of regard are designed to accommodate the information needs of the attentional mechanism that controls the normal ballistic movement of the eyes. The eyes use the spatial information and some letter information to right of the word currently fixated to concurrently "program" the point of the next fixation. A second mechanism, under cognitive or strategic control of the reader, determines how long the eyes will remain on the currently fixated word. The SPR's design is consistent with what is know about these mechanisms and gives the reader the information needed to maintain normal control. Consequently, reading speed with the SPR more closely approximates normal reading rates than other moving window formats which substantially slow the process.

The ScanPort, as noted, is a variable window and its size can be set by the user (or teacher) to present words, phrases, clauses, sentences, and other units encoded in the text file. Thus the SPR can be used diagnostically to examine integrative processes above the level of a single word. Window size, text unit size, text unit type, and other parameters encoded in the text may be set to enable detailed analysis of reading problems. A class of words, for example, function words, may be set to appear in the window whenever they follow the appearance of a content word.

In summary, the SPR is a good approximation to the expensive and personnel intensive eye movement tracking devices used in reading research. Furthermore, the system updates the most recent forms of the moving window by providing a more normal, text-like reading environment. The use of high and low intensity characters in the display accommodates the information requirements of virtually any reader with a reading vocabulary of at least a few hundred words. Readers using the system should approximate the reading rates they normally display with classroom reading materials.

The ScanPort Reader Package

The current user package consists of: (1) The SPR program diskette which provides for on-line processing of reading performance as described above; (2) the teacher analysis program or TAP; (3) the text input files diskette or TIF; and (4) the individual reading diskettes (IRDs) used for recording and maintaining student data. During any episode with the SPR, the student inserts her IRD into the PC. As the session proceeds, the record of her assessment and reading progress is posted and updated. Two files are maintained on each student's IRD: (1) a "setup" file containing identification data such as the student's name, sex, race, current, grade, teacher, and school; and (2) the student's assessment history for each episode. The assessment history also allows for inserting student and teacher comments for each episode. Once posted on the diskette, both files are locked and can only be unlocked by a password entered by the teacher. TAP, the teacher analysis program, is a master program which controls the types of analyses that will be run on the data on a student's diskette or for a group of students (the class report). For example, one of its features is a reading effectiveness profile. This report provides an ongoing profile analysis of the reader's progress in attaining effective and efficient reading. The student's teacher may at any time use TAP to analyze and print detailed or summary information on the student's reading performance with the test passages. With TIF, passages from reading tests or other texts used in the classroom may also be added to those already available in the system. Altogether, these features constitute a major innovation in classroom assessment: (1) Periodic reports may be generated electronically for any student in the system; (2) Individual data may be combined into group reports showing the reading progress of the class as a whole or for a given subgroup; (3) the content or focus of the assessment system may be updated to include those in use with particular students; and (4) the assessment of the student requires only minimal supervision, once the initial brief training period is passed.

On-Line Measurement

Like the IRI, the word-by- word reading paradigm is an on-line method for tracking the apprehension of each word in the text during reading. The word-time data are obtained while the student is reading, allowing more directly for inferences about the underlying components of the reading process. With most other methods, such inferences are made indirectly using comprehension or recall measures obtained at considerable delay from the actual time of reading. Furthermore, the types of analyses that can be made from traditional comprehension measures, for example, are relatively coarse. By comparison, the word times collected over the text in the moving window permit a very fine grained analysis of reading performance. One example of the type of fine-grained analysis possible with programs that track reading times on a word-by-word basis is shown in Figure 1. This graph shows the word-by- word reading times in milliseconds for a single reader for each word in a brief excerpt from a text. These data were obtained from a high school student during one of several sessions with the SPR. The numbers shown on the vertical axis provide for indexing word times in milliseconds. The words read by the subject which correspond to these data points are shown on the horizontal axis.

This graphic analysis of a single reader demonstrates one type of analysis that can be made using word reading times for individuals differing in reading skill. As shown, this reader demonstrates far longer than the average word time (250 msec) on certain words in the text, with long intervals of normal reading. This pattern is characteristic of a slow reader who is having considerable difficulty integrating some of the words and phrases in the text. By examining this type of detailed record, the teacher may determine whether the poor reader's difficulties lie with the content of the text or, in addition, with integrating the structural units signaled by the phrase and clause boundaries in each sentence. The SPR allows not only for this type of graphic analysis and presentation, but also for reporting a number of quantitative indexes of reading difficulty. The program also uses the data from the student's initial training episode to estimate key-pressing time. Thus, the key pressing factor may be estimated from initial practice episodes and, thereafter, used to adjust word times so that they more closely approximate the gaze-contingent paradigm used with eye movement tracking devices. The main differences between the SPR and the technically more sophisticated eye movement tracking device will be in estimates of the number of forward fixations and total reading time. Since good readers tend to skip function words about 60% of the time, their actual reading rates will be underestimated in the word-by-word condition. However, following assessment on a word-by-word basis, the ScanPort may be reset to the reader's comfort level. A more accurate assessment of reading rate will then be possible.

Flexibility

The flexibility of the SPR makes it easy to vary several factors which can affect how well the program matches the reader's strategies and the cognitive demands of the reading task. These factors include the number and length of the units included in the ScanPort, the content and attributes of the text, and the size of the unit of text. For example, the student's reaction times can be studied for any unit ranging from a word to an entire text. An example of the flexibility that characterizes the word-by-word paradigm is shown in Figure 2. The panel shows the response times for a single reader to the sentences in a running text presented in the SPR. The first part of the graph show the regressions to a prior unit of text—the keypress times back to an earlier position and then the rereading of the text. The remainder of the graph, except for a long reading interval over a single word, demonstrates a normal, smooth reading pattern, with only modest word time differences between words.

Sensitivity

The word-by-word paradigm is extremely sensitive to the linguistic attributes of the text and the reader's ongoing strategies in attempting to apprehend its meaning. Though norms for reading times for words and sentences might be useful, they are not necessary to note the trends evident in individual performance. Figure 3 provides a graphic analysis for a reader who experienced extreme difficulty with the text presented. These data show that the SPR can be extremely sensitive to even the most chaotic reading pattern. Here, extremely long word times for many words are recorded, as well as numerous, repeated regressions over the same material. Reliability

The word-by-word reading time data are highly reliable within and between individuals varying in reading ability. Much of the data we have shows that the same sentences will generate similar graphic and quantitative patterns for differnet groups of readers, slow, average, and good. In addition, research with the method shows that certain linguistic variables, e.g., a phrase break, produce similar patterns over sentences. Experience shows that users have little or no difficulty with the procedure. Slow readers seem to prefer the word-by-word paradigm to normal text, since it allows them to focus on individuals words. Fast readers experienced word- by-word reading as both natural and enjoyable.

From this we may expect that reading time patterns, which show many regressions, will also be reliable for individuals and for groups with similar reading skill. Given that both word times and regressions are both available with the SPR, even more detailed and reliable measures of patterns of reading behavior may be expected. The method should also be sufficiently sensitive and reliable to show even small changes in reading growth and development.

Thus, unless major changes are made in the structure and content of the test passages over test episodes, the word-by-word reading paradigm appears to be a convenient and ideal vehicle for monitoring growth and development in reading skill. Over relatively short time intervals, we should expect the same patterns within individuals for similar texts. Both sensitivity and reliability in a reading measure are needed to detect the effects of classroom interventions designed to facilitate reading skill.

Cost/Ease-of-Use

With the SPR, the collection, analysis, and reporting of reading time data is far less complex and costly than other more complex methods which obtain virtually the same data, with equivalent reliability and validity. The Manner in which the SPR is organized and packaged, furthermore, makes the collection of such data easy and inexpensive. All functions are done on the same machine: student registration, assessment, report generation, and text file encoding. Though a large amount of data are collected on each student at each episode, the data are kept in individual files on diskettes which may be expanded as needed. The system is easy to set up and a single machine should serve for assessment purposes for more than one classroom.

No additional personnel are needed to operate the system. Material and equipment costs are low. Only modest computer literacy is required to run any phase of the program. The primary replacement cost is for paper and ribbons to keep the reports going. To facilitate all this, the program comes with a brief user manual for day-to- day operation. A more detailed text brings the user to the theoretical rationale for the program, shows how to interpret and use the reports, and explains how to make use of the data for reading instruction.

The ergonomics of the system (the machine-user interface) has been studied in great detail to insure that its setup and maintenance are simple and involve little time consumption. Both the student and teacher interface are straightforward and machine-guided (Continuous use of a manual such as with a word processing program are unneeded). Once an IRD is inserted, the user's course is guided by simple menus that maintain direction to the end of an episode.

Assumptions

As noted earlier, the design of the SPR is configured to promote natural reading. The design of the ScanPort, furthermore, supports more than the word-by-word paradigm, although that is the mainstay of the program. The naturalness of the system in reflected in several ways:

Reader-Paced

The reading times for each word in the text reflect the natural pace of the reader. Individuals vary considerably in the pace with which they read materials, the number and lengths of the regressions they make, and the patterns they display for a configuration of words such as a phrase. All of the reading times reflecting on these and other parameters of the text are collected without disrupting the natural course of reading.

Reading Times Reflect Cognitive Processing

Since key-pressing time is factored out of the numbers representing the reader's word times, the only remaining factor of significance is that readers must pause on every word. Since the adjusted reading times for function words that might be normally skipped by good readers is very short, the effect on actual reading rates will tend to be nominal. However, whether the reader tends to skip or process the meanings of short words in peripheral vision can be accommodated through adjusting the ScanPort. This approach, as noted, will provide an approximation of the reduced number of word fixations that characterize mature and efficient readers.

Data from research on the word-by-word reading paradigm include sentence reading rates that range from 300-600 wpm, well within the norms for average and extremely fast adult readers. These data tend to indicate that, even when the port is limited to exposing a single word at a time, readers apparently adjust to the procedure and maintain their normal reading rates. In addition, these same data show that readers selectively respond to the linguistic features of the text. For example, they vary their reading times at important content words, phrase boundaries, and other key points in the text. Their reading times for each word are not rhythmic but reflect the momentary processing load induced by the word and their ongoing attempts to construct a coherent representation of the text.

Natural Reading Strategies Revealed

The word-by-word reading times from the SPR reflect the task-related strategies and the skills of individual readers, as shown in Figures 1 through 3. Where ordinary comprehension is the goal, the pattern of peaks and valleys in graphs of word time data are different from those induced by a recall strategy. The data for comprehension reflect a meaning-oriented strategy as shown by variations in word times but no marked peaks and valleys for phrase breaks. When recall is the goal, there is more attention given to the phrase boundaries that mark the idea units in the text. Apparently, this reflects a phrase-structure chunking strategy that facilitates a more memorable representation of the text. Accordingly, phrase structure chunking has been shown to optimize memory capacity during retention and provide linkages for later retrieval.

Word Time Patterns Reflect Reading Habits

Practice effects shown in studies of adults and children suggest the technique is sensitive to changes in reading skill. For mature and efficient adult readers, there is little or no change in their graphic patterns of reading time with increased practice. But, the word time patterns for children and less efficient adult readers become smoother with more practice.

The graph in Figure 4 shows the type of word time pattern that would be demonstrated for a good reader over familiar material. Note the smooth progression of word times over the words in the text, with only modest scallops and peaks for the most difficult and easy words. Such a pattern would also be shown for repeated practice on the same text, a technique that might be used to indicate greater automaticity in the reading process. Of course, the goal of the reading practitioner would be to bring the poor reader from the chaotic pattern shown in an earlier figure to this smooth pattern which implies a continuous integration of all of the words in a text.

Comparison with Other Methods

The key-pressing feature of the SPR may be considered unnatural but the program does provide a mechanism for factoring the associated time from the word-time record. Since key-pressing is largely a constant, it is unlikely to disrupt the pattern of relationships that we may be looking for, anyway. What is a key issue here is how well does the word-by-word paradigm compare to other methods which appear to have a greater claim to naturalness. Fortunately, studies have been done comparing data obtained with the word-by-word reading paradigm with those obtained by eye movement recording devices and the sentence-reading paradigm. These studies have been very encouraging for the validity of the word-by-word reading paradigm. Generally, all three techniques appear to be similarly sensitive to factors such as word length, word frequency, phrase breaks, and other linguistic features of coherent text. Though there may be an overall increase in word times for the word-by-word paradigm, the factors that affect reading times still remain in their relative relationships. For example, the word frequency and word length effects have roughly comparable weights in a sentence in the word-by-word paradigm—as they do in the other paradigms. Novel words also consume much more reading times than the other words in a sentence in each of the different paradigms. Reading time data has been shown to be systematically related to recall and comprehension performance, though the relationships tend to be quite complex. What is more likely to be of significance to the practitioner is the relationship between reading time patterns and recall or comprehension. The word-by-word paradigm, however, may have a small facilitating effect on comprehension and recall. This is presumably due to the longer reading times that have characterized this paradigm in some studies.

Structure Building

In recent research reading has been described as structure building. That is, the goal of comprehension is to construct a coherent representation of the structure of the information being read. To achieve this purpose, readers lay foundations for their mental representations. Words in certain strategic locations in a text, such as the first mention of a key topic, are the basis for foundation building. Thus, we find that readers pause longer on the initial key words in a text and on the first sentence. These initial pauses lay the foundations for mapping ever larger structures such as clauses, sentences and paragraphs. At each point in the structure building process a developing multi-level structure, with numerous branches, is constructed in memory. The constituents of a text, such as the clauses in a sentence, are mapped onto their own substructures which are, in turn, mapped onto still other structures.

This mapping of the information in a text into a hierarchical structure is the key to reading comprehension. If the text is lacking in coherence, or if the reader is unable to effectively process the information, a coherent mental representation may not be forthcoming. This brief mention of the structure building framework is of considerable significance here since the process is signalled by lengthened reading times at strategic locations in a text. At other times, e.g., the final sentences in a well ordered paragraph, reading times become shorter. They also become shorter for each successive mention of a novel word in a text. This effect for novel words is so marked that a repeatedly used novel word is ultimately processed by the reader at the same speed as ordinary words.

The SPR makes use of this knowledge in the manner in which each of the test passages is encoded in the TIF. The categories used to encode words include traditional indices of word difficulty such as a word's frequency, word length in number of characters, number of syllables per word, and so on. However, other individual indices and categories used for encoding text are intended as markers for structure building. As such, it is anticipated that the reader will, relatively speaking, spend more or less time on them. For example, more time should be spent on the first mention of a core word than on its fifth mention in the text. The initial key words in a sentence which represent a shift in the topics or subtopics of the text should also require more time. In other words, there should be a lawful relationship between the word times for a reader and the constituents in the text that suggest a shift in the process of structure building.

By encoding the test passages in this manner, reading times for important constituents in a text can be contrasted with reading times for less important constituents. For example, we should find in normal reading that words occurring at phrase and clause breaks should take more time to read than the words within those clauses and phrases. By summarizing this type of data for constituents for different levels in the text, some idea of the reader's success in structure building may be obtained. In other words, the reading time data can be directly used to measure comprehension. For example, a page of text that is not comprehended at all will show a random pattern of reading times over most of the content words in the text.

One of the goals of the SPR is to convert this type of information drawn from the reader's word times into a probable map of the reader's mental representation of the text. For example, if the core words relating to the topic of the text generally require more reading time than the remaining content words, then some indication that the topic has been processed exists. If, as is likely, the reading times for the core words also form a hierarchy of reading times, then additional evidence exists for an ordered mental representation of the topic. The schema for encoding text level integration is specifically designed to support such an analysis. Prior use of this schema has already shown that its higher order units receive greater weight in accounting for total reading time in a short text. As with the examples of reading times shown for phrase boundaries earlier, this means that more processing time was spent on the higher order units than on the lower order units. Clearly, integration of the idea units in a text takes time and effort and this time is strategically expended at certain locations in the text.The structure building framework and efforts in the design of the SPR to encode its concepts in the manner in which the reader's word time record is analyzed represents a major innovation in reading assessment.

Current Experimentation

To date, two versions of the SPR have been developed, an early version of the program written in HyperCard for the MacIntosh and the current version written in C++ for the IBM PC. The current program for the IBM PC has gone through many iterations and has been tested recently with small groups of college students. The main purpose of these early tests was to arrive at a working program and determine the accuracy of the reading time data collected with each keypress. At this point, the program is in working order and can be loaded with up to 100 passages at a time for trials with groups of readers. For a time, there was a problem with the granularity of the reading time data, but this was resolved by tapping into a source for the time samples other than the PC's clock. Currently, the program is sensitive to very small differences in reading times between words—on the order of about 1 msec. Different samples of word time data obtained between trials with different revisions of the program have demonstrated that the manner in which the program currently samples reading time data is adequate for diagnostic purposes in classroom reading.

The components of the program that are now in working order include (1) the main program—the SPR—the program that enables the reader to view the text in a word- by-word, phrase, or sentence mode; (2) TIF—the text input program; (3) the IRD—the individual diskette which records the student's data for a session and over time; and (4) a start on TAP—the teacher analysis program. Currently, this last program formats the data for individual reading sessions so that they may be input to other programs for analysis. Some additional background research is yet required before the TAP is suitable for diagnostic use at the classroom level.

Background research on the concepts underlying the program goes on at the time of the writing of this paper. In one such study, groups of disabled, poor, average, and proficient high school readers are being given several assessments, among them being a chunking test. The purpose of this research is to validate the phrase chunking patterns of different readers that appear to be signalled by the reading time data. Following this study, the SPR will tried with groups at both the high school and elementary levels to further examine chunking patterns signalled by both reading time data and the experimental task specifically designed to detect the size of the units that readers habitually encode into working memory.

The next six months should see a working program in all planned respects. The major focus of current efforts is the analysis program and the entry of large numbers of short, interesting reading passages that can be used in trials with the program. More than 75 passages are now available, ranging in difficulty from about grade 3 to advanced college material.

Presently, the program is far more than a laboratory curiosity.

A working model of the program is scheduled for use in a classroom of disabled readers in a major city school district in Texas during the Fall of '91. Additional tests of the program are now being arranged in other school districts in Texas. After Several months in these sites, the program will be readied for more widespread testing.

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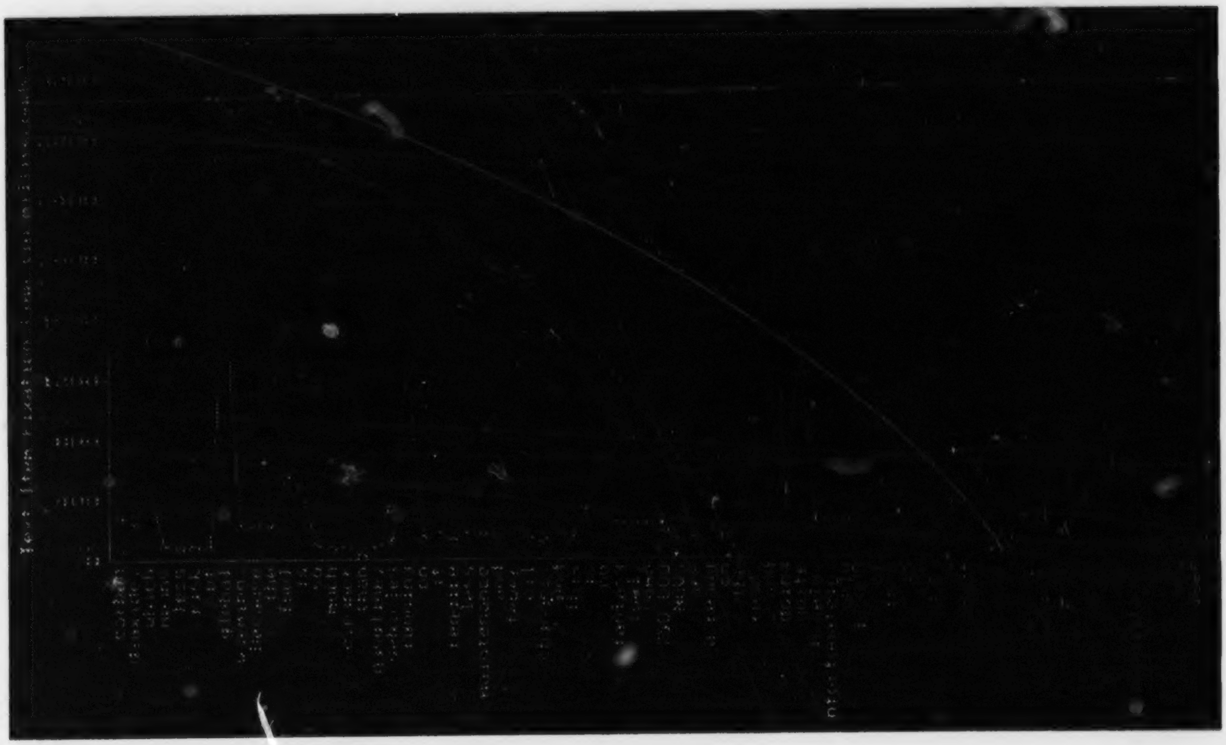

Figure 1

Figure 2

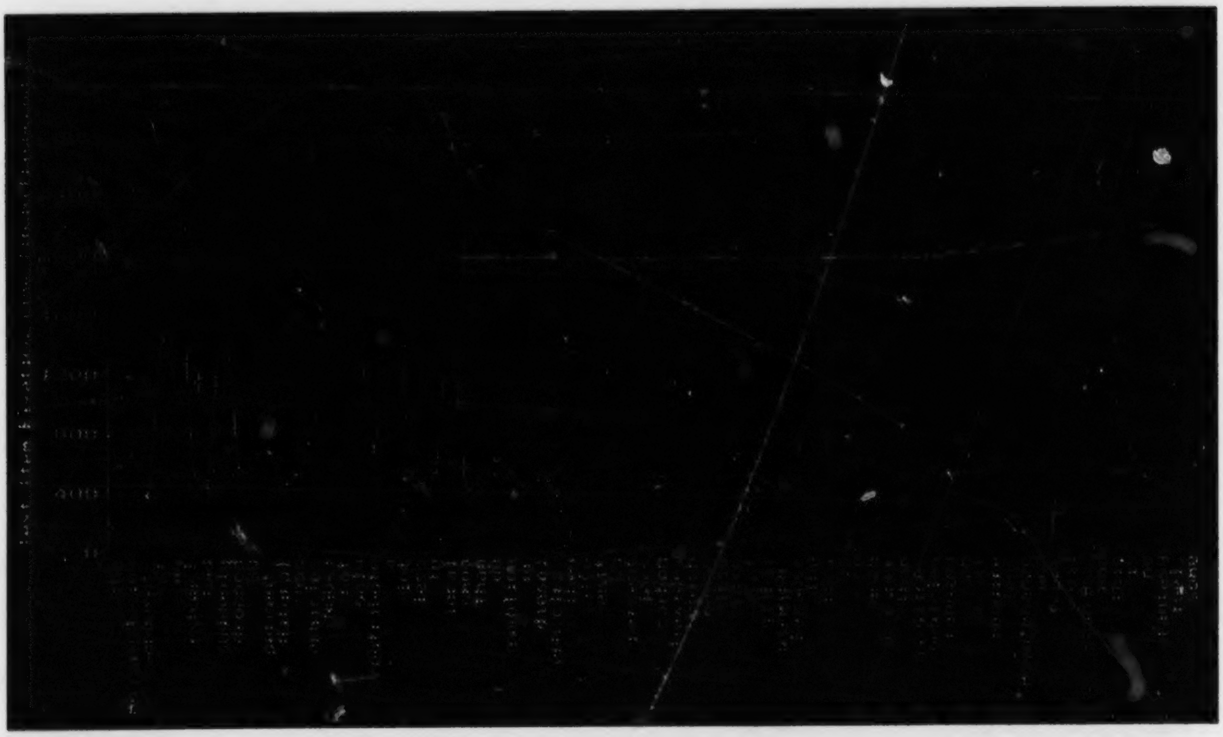

Figure 3

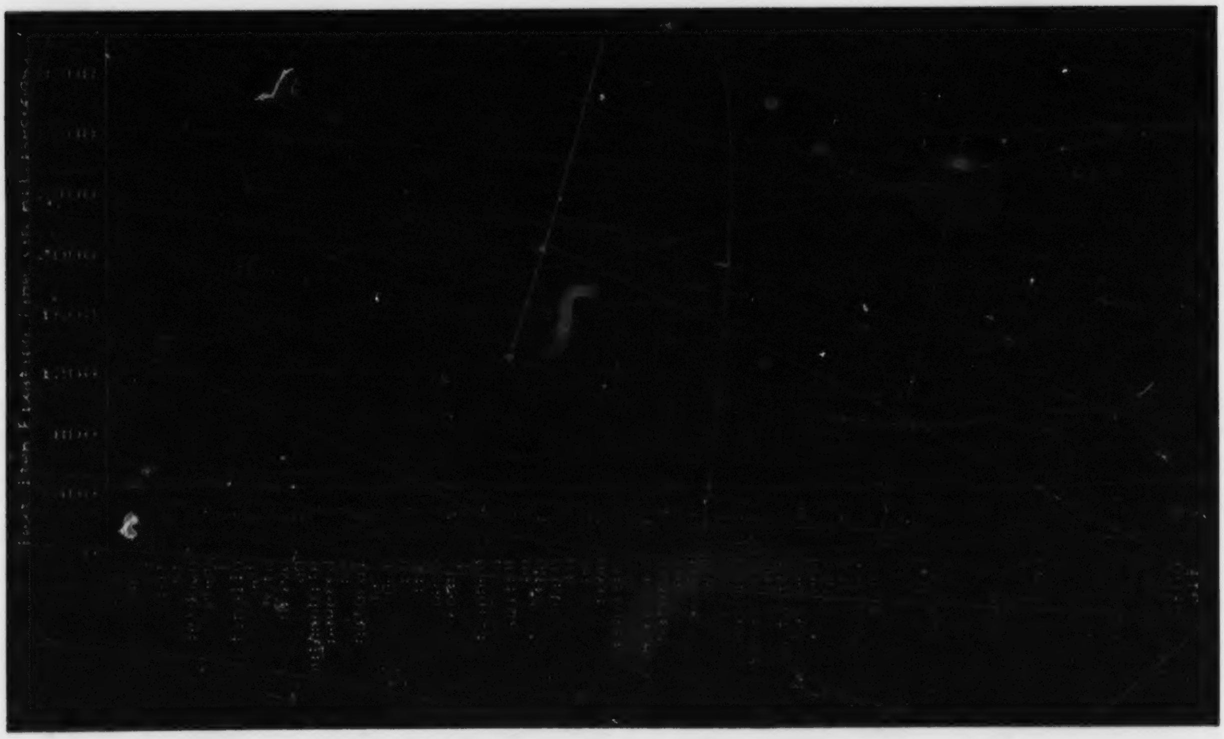

Figure 4

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Paper (T1-07)
Children's Perceptions of Computers and Writing: Their World View

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Abstract

Computers can open "windows of the world" for young children first learning to use them for their own writing. This paper describes how young children's perceptions of what computers are used for can influence their use of computers in the classroom, especially when computers are introduced as a student writing tool. Also included is a discussion of observing a community of writers writing for a real audience, rather than evaluating individual writing products. The examples given are from a research study of a first-grade classroom in which the teacher introduced a word processor to her students in a Writer's Workshop format. It was found that students who perceived the computer as a tool for writing used the computer for writing during Writer's Workshop, while students who perceived the computer as a form of entertainment used the computer to be entertained.

Introduction

> Today I forgot to put the disk in and I wrote a story and it showed. They're fun. It's fun to push the buttons.
> I think they're fun and I like writing on them. And you can play games like Pac Man, Flight Simulator, Wheel of Fortune. I would like to know how people build them.
> It gots a typewriter. It gots a big screen. It gots a printer. It gots a disk player. It gots buttons.
> I wish the buttons were in order. (Gunn, 1990)

It seems a computer can be many things to a six year old. These first-graders were participating in a study in which their teacher was learning to use the computer for writing and as a teaching tool in her classroom. Teacher Lynn Tenille added three computers to her first-grade classroom during the spring semester of 1990. She introduced FrEdWriter (Rogers, 1986), a public domain word processor, as a writing medium with her students during Writer's Workshop.

As the researcher and a participant observer in Lynn's classroom, I found that we must look beyond young students' actual writing samples as we explore the value in using computers for writing. Educators must also examine students' writing process and perceptions of what they see as the computer's role in their writing process. The pervading theme that emerged in this ethnographically-informed case study was that this classroom was truly a community of writers, each writer with his or her own "propriospects" (Goodenough, 1981), or world views.

This paper addresses the value of observing the community of learners as they write, of asking children how they feel and what they are doing, and of identifying children's perceptions of the role a computer plays in the classroom as they are introduced to the computer as a writing tool. In short, this paper suggest we trust children to give us answers.

Data Sources

Several sources were used in gathering data for this case study. Observations, participant observations, interviews of children and teacher, and written artifacts were used to explore the cultural perspective of a writing-with-computer environment. Observations were useful in helping answer the questions of "What is going on here?" "How do the participants interact with the activity and with one another?" and "How are participants and activities interrelated?" As the researcher in a participant role, I observed and participated in daily classroom life during blocks of writing for a six month period as a teacher's aide and computer consultant. Daily interaction with the teacher and students included conferencing with the teacher, and with individual or small groups of children. Information gathered during the participation sessions was recorded immediately following the session. Audio recordings were used whenever possible during these sessions. Entire tapes or portions of tapes were transcribed when dialogue was necessary for coding and sorting. Questioning of students and teacher was both formal through interviews and questionnaires and informal through conversations, to find out those things that can't be observed (e.g., feelings, thoughts, intentions, meanings attached to what is going on the classroom). All interviews were audio-recorded and transcribed. A pre-study questionnaire was used at the beginning of the study and a post-study questionnaire was administered at the conclusion. The focus for subsequent informal interviews were determined by journal entries and observation data. Written artifacts included student writing samples, journal entries by the teacher and also the researcher. Ethnographic methods offered the opportunity to paint a picture of the evolving writing community in which computers for writing were introduced to a first-grade teacher and her students and as they created meaning out of that introduction.

A Community of Writers

The children of Room 14, a first grade classroom in western Oregon, were interacting with their environment through realistic communication as they used computers to write their stories and as they read them to their fellow authors. Using computers to write in Lynn Tenille's classroom encouraged development in other language arts areas, such as listening, speaking, and reading. Children listened to stories read during sharing time, with the writer settled into the author's rocking chair. The children were communicating with each other as they interacted with their writing and with each other. Sounds could be heard continuously as children interacted with the computer screen and their own written word—an example of one of the development processes of shifting from "external to internal" described by Graves (1981). Graves and his colleagues observed beginning writers speaking aloud as they wrote and told other children what they were writing. This speaking aloud seemed to play an important part in the development of the writing process. The children in Room 14 were observed talking and listening to themselves as they wrote at the computer:

> Elizabeth: My phone number is ... My phone number is ... 6 ... 8 ... 9 ... Mrs. Gunn, Where is the dash on here?
> Mrs. Gunn: On the top
> Elizabeth: Oh, I see it... dash ... dash ... then a 2 ... and a 6 ... my number is ... then two ones ... 1 ... 1 ... My phone number is 689-2611! Oh! I can type my phone number. My phone number is 689-2611. Now I'll write my mom's name... (Gunn, 1990)

Elizabeth's chatter was a valuable part of her developing writing process. Chatter was encouraged by the teacher and was a part of most children's writing process, whether they were at the computer or using paper and pencil at their desk. Writing appeared to be an occupation for these first graders. They had a job to do, and the classroom climate was such that a sense of oneness could be felt by this visitor. Sharing of books, information, writing utensils, suggestions, time, and reading aloud to each other were priorities that were not only allowed, but encouraged and appeared to contribute to this community of writers.

Writing to Communicate

Children participating in this study did not show great changes as they switched back and forth between writing at their desks and writing on the computer. The study was not looking at children's writing quantitatively to find whether they wrote better one way or the other. Instead, I was interested first in whether a first-grader could or would write at the computer. As the study progressed, I found that first-graders could, indeed, write at the computer, and I observed children choosing to do so. A theme evident in most writing, whether at the computer or at the desk with paper and pencil, was that the writing was for real communication. Sometimes that writing was in the form of a message to the teacher or myself; other times it was a retelling of a favorite story or a new story. Books were published by these first grade authors and usually found a place on the chalk tray, in a basket of books, or on classroom shelves. Most importantly, though, was the handling the books went through. The stories were read and reread, both orally and silently, by an individual child, by pairs of children, and by the whole class. Favorite books were obvious. Those were the books that became worn, with tattered covers and dangling pages.

Graves (1981) observed that as young children began to see the need for communicating a message, they adopted more conventional left-to-right, top-to-bottom sequences and became more concerned with writing "how adults write." He called this development "time and space," and Ashleigh's writing was one example of this process:

> ASHLEIGH
>
> alabtpupes
> byashleigh
> wosaponatime thryusapupethayrekeyt
> puperfunesumtimsyupupe
> thalefd hpuleafdr

Ashleigh wrote this first story in late March and chose to print it out. She read her story orally with difficulty, stumbling over her words and asking for help. The interpretation was:

> Ashleigh
> All About Puppies
> by Ashleigh
> Once upon a time there was a puppy. They are cute. Puppies are funny some times. [couldn't fit "yupupe" into context of story, left out]
> They lived happily ever after.

Ashleigh's next visit to the computer highlighted her need to see words and spaces to make sense of her writing. While she was typing her next story, Ashleigh asked how to get down to the next line. She began using the RETURN key when she wanted to show space:

> olabat
> ketens
> Byashleigh
> yosapo

atim
thr
yus
akat
tha
lev
hpule
afd
afdr

This interpretation came much easier, as Ashleigh read her story unhesitatingly:

All About Kittens
By Ashleigh
Once upon a time there was a cat that lived happily ever after.

When Ashleigh's view of what writing should look like did not match with her first computer printout, she accommodated her view by finding an alternative to create space.

Many of the children wrote longer stories at the computer than they did with paper and pencil. Wes wrote this story during his second fifteen-minute session in late March:

the ninga Wunsthar wus a niga.
He went to fitsum wun. He did he wun.
He got an aword the End.

Child's oral interpretation:

(The Ninja. Once there was a ninja. He went to fight someone. He did, he won. He got an award. The End)

During his next session at the computer, two weeks later, Wes asked to work on his previous story, so I helped him load the saved file by pressing CONTROL and the letter L. Wes wanted to type the title from memory and asked how to spell *Ninja*. The file was not found, so we typed SHIFT and ? to find his original file name. *Ninja* was spelled *nija*. Looking at this story, Wes said, "I need to erase *The End*." When asked why, he replied, "Because I want to add some things to it" (Gunn, 1990):

the ninga Wunsthar wus a niga.
He went to fitsum wun. He did he wun.
He got an aword .he fhgt a hoii lotfo
other peple. he was a hiro theshrif game
him a medl the end.

Child's oral interpretation:

(The Ninja. Once there was a ninja. He went to fight someone. He did, he won. He got an award. He fought a whole lot of other people. He was a hero. The sheriff gave him a medal. The End)

The next time Wes was at the computers during Writer's Workshop, he again asked to work on The Ninja. This is his finished version:

The Ninga By Wes Carney (pg. 1)
Once there was a ninga. He went to fight someone. (pg.)
He did and he won. (pg. 3)
He got an award. (pg. 4)
He fought a whole lot of other people. (pg. 5)
He was a hero. (pg. 6)
The sheriff gave him a medal. (pg. 7)
He went home. (pg. 8)
There was more to do. (pg. 9)
He fought and fought. He saved the town. (pg. 10)
He got married (pg. 11)
But the Ninga got her back. (pg. 12)
The town had a celebration. (pg. 13)
The End (pg. 14)

This version was published from the computer, with Lynn sitting beside Wes to conference. During the conference, Wes was involved in deciding what he wanted on each page of his book. He was also advised on the use of capital letters and periods. Lynn typed conventional spelling for Wes's invented spelling. This conference was typical of any conference done with paper and pencil, with the exception of the task that included deciding which sentences were to be included on each page.

Wes's sharing of this particular story illustrated Graves (1981) sequence shift from "egocentric to sociocentric." Wes settled in the author's chair in the library corner and began reading The Ninja. As he came to page twelve, "But the Ninga got her back," he became upset. "You forgot part of my story," He told Lynn. "The Ninga's wife got kidnapped, and you didn't print that part out." Lynn and Wes went back to the computer, loaded his Ninja story, and read the text. There was no kidnapping in Wes's version, but he continued to insist that he had written it there and that the story needed this part to make sense. "It doesn't make sense. His wife was kidnapped." Wes insisted. He was concerned about the product of his writing and his audience. Wes had learned the need to make his written communication interpretable, as his writing process shifted from egocentric to sociocentric.

During the same time period, from late March to late May, Wes wrote three rough draft stories with paper and pencil:

Story 1:
Wut I lik on cnptrs by Wes
I like splign on the coputrs
it is fun on cputrs
I like cuputrs
the End

Child's oral interpretation:

(What I like on computers by Wes. I like spelling on computers. It is fun on computers. I like computers. The End)

Story 2:
Fot Ball by Wes
tare wus a Fot Ball tim tare name wus 40 9rs
thay plade a game
Paul Havey Made a tuctdon
Paul was so gud He wun a game fore the hol tim
than Wes Carney wun a game for the hol tim
Paul Havey and Wes Carney wer in footBall cards
Thae wint to the majr lig
Thae wun evry singel game
Thae got to big hiwg trofis
than thae retirde
the End

Child's oral interpretation:

(Football by Wes. There was a football team. Their name was 49ers. They played a game. Paul Havey made a touchdown. Paul was so good he won a game for the whole team. Then Wes Carney won a game for the whole team. Paul Havey and Wes Carney were in football cards. They went to the major league. They won every single game. They got two big huge trophies. Then they retired. The End)

Story 3:
All abat Morgan By Wes C.
Morgan as a talit for munny
and he al so as a talit fore fud
He as a talit fore tutls
and He as a talit fore
the End

Child's oral interpretation:

(All About Morgan, By Wes C. Morgan has a talent for money. And he also has a talent for food. He has a talent for turtles. And he has a talent for movies. The End)

Each of these three paper and pencil stories were written during Writer's Workshop without adding onto or changing any of the story. When a story was finished, it was put in to Wes's Writer's Workshop folder and was taken out again only for conferencing when all three were completed. The words The End meant exactly that when Wes wrote with paper and pencil, but when he used the computer for writing, *The End* was a place holder for the next session. Wes's view of writing with a computer opened new windows on his own writing—stories were boundless, ongoing, never-ending.

The Role of the Computer

Children's perceptions of computers and the use of computers in their lives played an important role in how they were used in Lynn Tenille's classroom. When asked "What do you think computers are for?" children in Room 14 offered the following responses. They said computers are for:

- typing
- for writing books
- to type stuff like letters
- to write notes
- to remember stuff
- to write stories
- to do science
- to write good books and books to sell
- to learn
- work on it in an office
- to help us learn to read
- for playing games
- to use for words
- for playing video games
- to make things
- computers are for learning to write (Gunn, 1990)

Twenty-three percent of the children in Room 14 had a computer in their home. Those computers were used for playing games, or in some cases, for writing. When asked what they used a computer for, the range of student responses ran from arcade video game playing to writing with a computer for homework purposes.

The range in perceptions can be seen most clearly with Drew and Morgan, two children in Lynn's class. Drew and Morgan had apparent differences in perceptions of computers and their use, as evidenced by their behavior at the computer. Drew, probably the most proficient user of the keyboard, said his family's computer is used for "writing my homework when I'm sick and my mom uses it for her homework for school." Drew used the classroom computer only for writing during his first visit to the computer, even while others around him were experimenting and playing with FrEdWrit*er*. An example of Drew's writing includes this story written with paper and pencil over several half-hour sessions (Gunn, 1990):

Charles And Drew
By Drew
Charles wit srten (Charles went surfing*)
I wit srfn (I went surfing*)
We cipt on go (We kept on surfing*)
We stil cipt on goer (We still kept on surfing*)
We got to shoo (We got to shore*)
We wit hom (We went home*)
We LevD HaP ULee evraFrt (We lived happily ever after*)
The End

(*Child's oral interpretation)

Drew wrote just as quietly and surely at the computer, asking for little help as he searched for the keys that would spell his words on the screen. One of his first stories on the computer during a fifteen minute segment, while shorter than his paper and pencil story above, continued in the same style. Drew's writing was consistent as he went from one writing medium to another (Gunn, 1990):

Drew
I gt awt (I got out*)
I wit to the Stur (I went to the store*)
I withm (I went home*)
I Loiv hapu Leevtraftr. (I lived happily ever after*)
*Child's oral interpretation

It is evident from Drew's writing samples and classroom observations that he uses a computer as a tool for writing, just as his paper and pencil are writing tools when he is at his desk.

In contrast, Morgan, Room 14's resident speller and writer of chapter books, did not begin to use the computer for writing until his sixth visit. He enjoyed using *FrEdWriter* as an arcade game, announcing to neighbors periodically what his score was by using the "Size" counter at the top of the screen. When Morgan was asked at the beginning of the study where he had seen computers outside schools and what they are used for, his reply included: "spaceships for taking pictures, fire stations where they type in problems, police cars for typing in problems, and little computers to shoot pictures into TV's." Morgan said computers were for "playing games." When asked if he had any questions he would like answered about computers, he replied: "I'd like to know how they put the games inside the disk." His view of computers is varied, but game-oriented, compared to many of his classmates' responses (Gunn, 1990):

- track down aliens from a planet and suck them up with a vacuum cleaner (from a TV show)
- stores—write books and stuff
- libraries—write stories
- banks—to run checks through
- write things down
- on 911 TV show, it shows phone number and what the name is
- store—to sell
- Movie shops—they write the story, like *Friday, the Thirteenth*
- factories make buildings on them
- offices—work
- Channel 6—write stories
- stores—print things
- my dad's workshop—he writes
- eight children (one-third of class) replied that they had not seen computers outside of school and couldn't tell what they might be used for. (Student interviews)

Morgan, a reader of Alfred Hitchcock stories, was working on a book with paper and pencil when I first began observing in Lynn's classroom in December. He continued writing on the same story until the end of February. While other first-graders were writing one sentence per page, Morgan's story was line after line of text on each page:

Night of The creapy huose
by Morgan

once there was a huose that creaked and creaked. But one dark dark Nite The door creaked open and nobody was at the door! And the poeple who lived there heard foot steps inside the house. they saw the bristles (changed to curtains in conference) But they kept on hearing more they wer very scared. (end of page 1)

But they kept on hearing rrrrrrrrrh! rrrrrrh! creak! (end of page 2)

But they saw a little bit of skin and they found that it was there uncle. he was just waring his costume (end of page 3)

and they lived Happaly ever after. (end of page 4)
THE END (end of page 5)

A second story written with paper and pencil during this same period illustrates Morgan's knowledge of words, story structure, and spelling development:

Land Before Time
by Morgan

once apon a TiME There Wose a Grate earthquake

The Land SPLiT

Little foot and hiss MoTher Were seperated.

He Had To Walk the Grate vally By Him Self But Preetty soon sara Arived The Same Persen Little foot Saw at the begining.

for Days and Days They Walked But Then Ducky peatree and spike came to joun (join.)

But Then! Sharp Tooth Came! But then Little Foot Got an idea you Go Down Said Little foot To sara and get Behind him and make him turn eruond (around) to Get his atenckin (attention) and will (we'll) rock on him and heel (he'll) fall in the lake

They had lots of Tunels (tunnels) To go Threw (through) But! one Day way under They saw the great valley.

It was the Great vally!

The End

Most of Morgan's time at the computer was spent using the counter as an arcade game to keep score of how many letters he typed. Some letters were gained by keeping one finger down on a key to repeat a letter as the "score" increased. Classmates could hear Morgan yell occasionally, "I've got a hundred... I've got four-hundred... I bet I can get a million!" Morgan completed one story during his computer sessions, at the insistence of his teacher:

> MORGAN
> THOMAS WILEY
> The MOUSE AND THE CAT by Morgan
> Once there was a cat and a mouse.
> the cat always chased the mouse.
> one day the mouse said I,am tired of
> being chased all the time. help!
> said the mouse. the cat is chasing
> me. he ran into his hole and sat
> there. he sat there for days and days.
> but one night the cat went to sleep
> and the mouse crept out of his hole.

Morgan was beginning to use the computer for writing, but he continued to write elaborate chapter stories only at his desk using pencil and paper. In late April, I asked Morgan what he was writing in a rough draft paper booklet. He told me: "I'm writing a book on how to draw and it's hard to think of a way to start—there are three sections and all are different." (Gunn, 1990). Using paper and pencil for his writing, Morgan was writing chapter books. From observing Drew and Morgan writing at their desk and at the computer, it appears that their perceptions of what a computer is used for guided their use of the computer for writing. Drew saw the computer as a writing tool at home, and he used the classroom computer the same way as he used paper and pencil. In contrast, Morgan used the computer much like an arcade game, even within the context of Writer's Workshop.

Do first-grade students write when they have access to a word processor, or do they see the computer as a machine to play on? This was a question that emerged and was subsequently addressed in the reported study. A computer can be a writing tool, but it will not teach children to write better than with paper and pencil (Hoot & Silvern, 1988; Cochran-Smith, Kahn, & Paris, 1988; Kurth, 1988; Hawisher, 1989). In Room 14, children using capital letters and periods in their paper and pencil writing used capital letters and periods on the computer. Children writing with invented spelling with paper and pencil used invented spelling when they wrote on the computer. Children who consistently played around at their desks and had nothing to show for a Writer's Workshop session usually had nothing to show after writing at the computer. Concepts of print were comparable, whether writing on a computer or using paper and pencil. These observations were consistent with literature reviewed. In the end, however, a child's perception of the computer as a writing tool or as an arcade game influenced whether the computer was really used as a writing tool in this first grade classroom.

Conclusion

What does this mean for teachers who want to use a computer in their writing program, then? First, as with reading and writing, we need to *ask* children what they perceive. When teaching children to read, for example, it is necessary to ask what reading means to them so we know whether they view reading as making meaning of text or sounding out letters. If a child perceives reading as sounding out letters, then we first must change that perception so a child can see that reading is making meaning, interacting with text. As reading teachers, we do this by reading children's literature aloud, by modeling reading strategies, and by demonstrating and talking about our own reading process. It is just as necessary to ask children about where they see computers used and what they are used for.

Secondly, it is important for teachers to model writing with a computer so children see the computer as an effective tool for writing. As children watch us write with a computer, we can verbalize our process. We can let them see and hear us delete mistakes, revise our text by trying different words, move text around, save our writing, and easily print out multiple copies. A VCR monitor or LCD projection device connected to the computer for large screen display and for group writing or strategy lessons make classroom demonstrations easier. These classroom demonstrations show our students that the computer has value beyond entertainment. We need to model writing for real audiences, for then students will see that our writing is a way of communicating. Students need to see us write letters home to their parents using a computer. They need to see us keep anecdotal records and watch us save our revised versions frequently. Students can also see us use the computer as we take notes during group discussions. Modeling our writing process allows our students to see the computer integrated into our classroom in a way that combines technology with obvious needs—writing in a content area.

Addressing these perceptions means that we can model an appropriate world view of computer use in a writing classroom and guide students in developing or adjusting their perceptions. Children may view writing at the computer as a different process than writing with pencil and paper. Children often see computers used in the context of entertainment before they see them used as a writing tool. This perception of a computer's role may direct our students' uses of the computer in the classroom. Modeling our own writing process with a computer may be the first step in developing children's perceptions of the computer used as a writing tool.

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Special Presentation–ACM/SIGCAS (T1-08)

Ethics in the Classroom–Possibilities for the Proposed ACM Code

Abstract

Alternative strategies for teaching computer ethics will be debated in the context of recent activity to revise the ACM Code of Ethics. The panelists are all teachers who are members of the ACM SIGCAS Task Force for the Revision of the ACM Code of Ethics. First, the newly proposed Code of Ethics will be described and contrasted to other codes of computer ethics. Then the question of the instructional role of ethical computing codes will be posed for discussion. Panelists will present alternative approaches for teaching ethics in computer-related courses.

Panelists:

Ronald E. Anderson
University of Minnesota
Wayzata, Minnesota

Donald Gotterbarn
East Tennesee State University
Knoxville, Tennesee

Alex Hoffman
Fort Worth, Texas

Doris Lidtke
Towson State University
Baltimore, Maryland

C. Dianne Martin
George Washington University
Washington, D.C.

Projects (T1-09)
Tools for Special Students in Regular Classrooms

It Takes Two Plus Computers Opens Windows for Orthopedically Handicapped Students

Mary Puckett
Arlington, Texas

Abstract

During the 1988 - 1989 school year, Mary Alice Puckett, a first grade regular education teacher in Arlington, Texas, took the challenge of mainstreaming five orthopedically handicapped students into her first grade Science and Social Studies class. The school year was a learning experience for everyone involved. That is why Mary Alice produced a teacher training video called It Takes Two Mainstreaming as an independent study at Texas Wesleyan University. The video is a valuable tool because it demonstrates to administrators, teachers and related service personnel how special-need students can be successfully mainstreamed into a regular classroom. It also offers an excellent opportunity for increasing community awareness, teacher training and student understanding.

Mary Alice continues to challenge herself to create innovative lessons which enable special-needs students to be included in the regular classroom. She believes that all children have the same basic human needs and that teachers need to create high interest lessons which incorporate different learning styles. Computers play a key role in helping orthopedically handicapped students to access information.

It Takes Two Mainstreaming plus computers can open windows to the world.

The Visually Handicapped Student Using Computers

Austin Cron
Alamo, Texas

Abstract

Abstract not available at press time

Writing and the Learning Disabled Student

Polly Buenger
Houston, Texas

Abstract

Abstract not available at press time

Projects (T1-10)
Planning and Curriculum

Long Range Plan for Technology: What's Next!

Nancy Robbins
San Antonio Independent School District
San Antonio, Texas

Abstract

The San Antonio Independent School District is a large urban district serving 57,000 students. The majority of the student population is identified at-risk. As we formed a vision for 2001 we developed a plan to meet our vision.

Our planning process began by looking into the future to describe how our schools and classrooms would look in 2001. We identified three factors to successfully enable technology; training, support, and access. In addition to these three factors we included communications and planning and evaluation as our five major issues in developing goals for technology use in SAISD. Related to each issue, goals were drafted which addressed students, instruction, community, and management.

June, 1992, will see the completion of year two of our plan. Both planning committees, district and superintendent's, are still actively involved. A mission statement was developed for year two which gave the district team focus. Implementation of the plan, changing into a standards committee, evaluating, and developing implementation targets for 1992-93 are all part of the ongoing responsibility.

A Blueprint for Multiyear Technology Planning: A Status Report

Ron Crowther
Arlington Independent School District
Arlington, Texas

Abstract

A district computer technology plan will be explained that does not become outdated faster than the equipment it is intended to provide. The plan will be a catalyst for the restructuring of our schools. The plan emphasizes site based management. The use of technology is designed and initiated by teachers, departments within a school, or entire schools. The plan allows for changes in technology, and provides for innovations in software. The presenters will explain how over 250 members of nineteen subcommittees collected input from thousands of district employees. This data was used by administrators and the school board to formulate the district's Multiyear Technology Plan.

The New York State Model Schools Program

Frances Brewer and Lynn Reuss
Madison-Oneida BOCES
Verona, New York

Abstract

Abstract not available at press time

Project ABCD Alternative Blueprint for Curriculum Development

Nancy McClaran
Austin, Texas

Abstract

Abstract not available at press time

Projects (T1-11)
Computer Literacy/Computer Science

HyperCard Day-by-Day for Computer Literacy Classrooms

Linda Roman
New Caney, Texas

Abstract

Abstract not available at press time

Window to C–An OnScreen Tutorial

Scott Barrett
Conroe, Texas

Abstract

Abstract not available at press time

BITS Team Competition–The Human Computer

Gary Hicks
Fort Worth, Texas

Abstract

Abstract not available at press time

A Hypermedia-Based Approach to Teaching Computer Ethics

Judi Repman, Herman G. Weller, and Gene E. Rooze
Texas Tech University
Lubbock, Texas

R. Duane Parker
Slade Independent School District, Texas
Slade, Texas

Abstract

The focus of this presentation will be the *Computer Ethics Stack.* Class discussions of the social issues that arise as a consequence of computer use have been suggested as an alternative to preaching rules and regulations. Students may be reluctant to participate in these discussions, perhaps because they lack knowledge level information or because students are reluctant to disclose their opinions for fear of rejection.

The *Computer Ethics Stack* presents students with a series of scenarios devoted to discussions of computer ethics: piracy, privacy, theft of information, and theft of goods or services. The student chooses whether or not to engage in unethical behavior and whether or not to allow such activity to continue after having observed it. Each scenario includes 2-3 stories presented from a different character's point of view. Students are allowed to make decisions for each character, which are followed by an examination of the possible consequences. During the scenario students are able to select key terms for further explanation. Copies of the stack will be available in exchange for a blank disk at the presentation.

Special Presentation–ISTE (T1-12)

Exemplary Projects in Telecomputing Around the World

Trevor Owen
Simon Fraser University
Burnaby, British Columbia

Pat Redhead
Edmonton Public School District
Edmonton, Alberta

Ron Place
Academy School District
Colorado Springs, Colorado

Betsy Frederick
Albuquerque Public Schools
Albuquerque, New Mexico

Abstract

Students and teachers engage in curricular activities and discussions every day. In the last few years these communications have also taken place without regard to geographic location or time. Using computers and modems classes have learned to interact for meaningful discussions and comparisons. This session will present projects chosen from proposals submitted to SIG/Tel and represent a few of the most exciting activities currently being conducted to enhance the teaching and learning process within a variety of content areas, grades and locations.

Projects (T1-13)
Tools for Teachers

Now You've Got Computers: How Do You Get Them Used?

Rachel Pinson
Mountain Brook High School
Birmingham, Alabama

Abstract

Because all school situations and computer facilities are different, one of the obstacles that comes with the implementation of computer programs and equipment is that of teacher training. Many of the reasons that teacers fear changes in technology have to do with the fact that there is not adequate training on new computer equipment before they are asked to implement the machine and its software in their classes.

This project has involved the creation of a Teacher's Guide to our Computer Lab that is available to any faculty or staff member that wants a copy. The guide contains information about ways that the lab can be used; software that is available in the lab; specific instructions for uisng that software; information about our network; lab rules; sample assignments that can be used with the computers; information about emerging technology such as telecommunications and videodiscs; and readings from magazines, newsletters, and journals that might apply to use of the lab for instructional purposes.

Teaching Old Dogs (and Young Pups) New Tricks with Technology

Diana Cox
Amarillo College
Amarillo, Texas

Abstract

Because of good planning, much work, and a little luck, Amarillo College received a Title III Strengthening the Institution grant in 1990. One activity stipulated in the grant was to establish a faculty development center for technology training. In the spring of 1991, the center opened in a renovated room in the Lynn Library with a staff of three: the director, an instructional design specialist, and a secretary. In a faculty contest, the name Alpha Center was selected. The use of the center has already burgeoned to include how to budget for hardware/software, how to use the LAN with WordPerfect Office, how to select materials for classroom presentations, etc. Speakers, travel, and consultants are available for faculty training through the grant. The Alpha Center Board of Directors meets monthly to discuss current needs, concerns, and on-going projects. In its second year, the name and place are now common knowledge throughout the campuses.

Creating Manuals for Technology Instruction

Victoria Schuckmann
Jefferson County Public Schools
Louisville, Kentucky

Abstract

Jefferson County Public Schools, Louisville, KY has completed "The New Kid in School" Project. This project placed a 32-unit LAN and other technologies in each of the district's 150 schools. To assist teachers in fully utilizing these technologies, manuals were created. The topics for the manuals are: BankStreet Writer; Logo for grades K to 5; Curriculum Correlations for grades K to 5; Mathematics, Social Studies, Science, and Language Arts for grades 6 to 8; and Lessons for the Macintosh for grades 9 to 12. The manuals were written by classroom teachers with the help of the Computer Education Support Unit staff. This presentation will describe the planning, development, publishing, distribution and use of these manuals. Copies of the manuals will be available for participants preview.

Computer for Teachers Revisited

David A. Flower
Fort Wayne Community Schools
Fort Wayne, Indiana

Abstract

For the last three years, the Fort Wayne Community Schools, Fort Wayne, Indiana has been allocating approximately 50 computer systems per year for assignment to teachers. Many other school districts have taken, and some are currently considering, similar action for their teachers. These projects are not as simple or straightforward as they might appear. After these three years, there are a number of questions still unanswered. Should all teachers receive the same system? Comparable systems? Can a case be made for some teachers having high end systems, while others have a beginning level system? What software is most frequently used by teachers? What can be done to provide teachers with access to software that will be used infrequently, but that does provide the teachers with functions that are not easily duplicated in other ways?

Our project is still researching these and other questions and our findings and feeling will be shared with the audience.

Special Window (T3-01)

Enhancing Instruction for Native Americans through Computer–Mediated Communications

Paul Resta, Moderator
University of Texas at Austin
Austin, Texas

Abstract

Presentation and demonstration of use of electronic mail for education-oriented communication among native American students and with indigenous peoples in other nations. Description of the goals and organization of the the ENON network and example student communication activities.

Panelists:

Kwok-Wing Lai
Department of Education, University of Otago
New Zealand

William Mehoja
U.S. Bureau of Indian Affairs
Washigton, D.C.

Arie Pilz
University of New Mexico
Albuquerque, New Mexico

Special Presentation (T3-02)

Multimedia in the Classroom: Experiments & Experiences

Elliot Soloway, Panel Chair
University of Michigan
Ann Arbor, Michigan

Abstract

Learning is all about self-expression, communication, participation: if technology can tap into those intrinsic motivators, then such technology can indeed facilitate learning. While words are one modality in which to express, to communicate, they are surely not the only such means; in fact, we are coming to realize how few individuals feel comfortable and competent using words. The new information technologies that will come to maturity in the 90's offer an opportunity for learners to express, to communicate, to participate through pictures, video, graphics, and sounds — as well as words. The challenge, then, is how to channel the technology to make it effective in an educational setting.

The panelists have all had first hand experiences using multimedia technologies with schools, teachers, and kids. Our intent in this panel, then, is to share those experiences with NECC attendees. Hard-and-fast prescriptions will not be given; we all know how cookbook teaching just doesn't work. Rather, we will raise questions, present viewpoints, and illustrate using concrete examples.

The barriers to experimentation with multimedia, e.g., cost, fixed curriculum, are coming down. Provocative models are needed to guide productive exploration. The articulation of precisely such models is the goal of this panel.

Panelists:

Fred D'Ignazio
Director, Lansing Teacher Explorer Center
East Lansing, Michigan

Anne Porter
School of Education, Oakland University
Rochester Hills, Michigan

Saul Rockman
President, Rockman et al.
San Francisco, California

Dan Schultz
State Board of Education
Michigan

ADAPT Spotlight (T3-03)

Interactive Multimedia Applications for Special Education

Ted Hasselbring
Peabody College of Vanderbilt University
Nashville, Tennessee

Abstract

This session will focus on recent multimedia applications that can be used with special needs students. The advantages of multimedia on learning will be discussed and specific examples of multimedia applications will be presented. Applications that will be presented will come from the areas of mathematics, reading, and language arts. In addition, participants in this session will be introduced to a shareware authoring tool that can be used to develop multimedia presentations for the classroom.

Special Presentation–Panel (T3-04)
The Computer Equity Expert Project: A Trainer–of–Trainers Model in Action

Jo Sanders
Women's Action Alliance
New York, New York

Abstract

The Computer Equity Expert Project, funded by the National Science Foundation, I.B.M., Hewlett Packard, Intel, American Express, Xerox, Chevron and Westinghouse for over $1 million, has selected and trained 200 educators — representing every state in the country — to work with their faculty members in encouraging girls in computing, math, and science. Trainers, who include classroom teachers, superintendents and everything in between and about half of whom are computer educators, have become committed gender equity advocates whose activities range far beyond those they originally agreed to perform. Most are achieving remarkable success in their schools and beyond.

This session will explore how the trainers are carrying out their computer equity activities in very different environments, meeting different receptions from their faculties, and drawing upon different resources. Participants will gain a broad variety of ideas and strategies for replicating the trainers' computer equity success in their own schools.

Special Presentation–ISTE (T3-05)

Policies, Possibilities, and Perspectives on Educational Telecommunications

Abstract

Who owns the electronic highways? What obstacles stand in the way of universal connectivity for the entire educational community? What opportunities now exist for special needs individuals using telecommunications technologies? Is it possible to allow every teacher and student access to the world of telecommunications?

In 1991 Congress passed, and President Bush signed, the High Speed Computing Act—what does this mean for educators and students? Panel members represent a cross section of policy makers and those who try to influence policy decisions. We will address concerns of state and regional initiatives, telecommunications for physically challenged individuals, and international perspectives on global telecommunications.

Panelists:

Chris Clark
Culver Academies
Culver, Indiana

Art St. George
University of New Mexico
Albuquerque, New Mexico

Chuck Lynd
Ohio State University
Columbus, Ohio

Richard Ried
Appalachian State University
Boone, North Carolina

Connie Stout
Texas Education Agency
Austin, Texas

Lynne Schrum
University of Oregon
Eugene, Oregon

Paper (T3-06)

A New Opportunity to Prepare Technologically Competent Education Majors

John F. Beaver
SUNY College at Buffalo
Buffalo, New York

Abstract

This paper examines the troubling technology incompetence of our undergraduate education majors and several current models for improving the situation. An integrated approach for increasing the technology competence of undergraduate education majors is discussed in detail—including the advantages that this program offers over other models.

In the recommended model, majors take technology competence courses designed specifically for educators where they develop the foundation they need. The courses provide students with a broad, positive introduction to educational technology. In subsequent methods courses, students learn to apply technology in content specific ways. In "field" and student teaching experiences, majors work in classrooms where the same resources that they mastered on campus are available for classroom use. In this way, majors can practice using the technology instructionally under the guidance of knowledgeable supervising teachers and college faculty.

Statement of Problem

Faculty in the colleges of education across the country are charged with helping the teachers of tomorrow develop the varied skills necessary for teaching in the 1990's. Our students must develop the skills and understandings necessary to find teaching positions today to be successful in the classrooms of tomorrow. Although our colleges of education are generally doing a good job in preparing students for the teaching profession, they are not doing well at all in developing a key competency like the ability to use computer-related technologies educationally. Judith Axler Turner asserts that, despite the importance of educational computing, "few colleges of education have incorporated computers into their curricula."[4] Dave Moursund is even more emphatic in his criticism: "by and large our colleges of education are doing a miserable job of preparing teachers to deal with the Information Age."

Part of the reason that our colleges of education are doing a "miserable job" is that the faculty members in the education departments lack expertise in the instructional use of technology. If we expect faculty to provide the vision and understanding needed to guide the development of instructional computing programs, we must encourage them to increase their computer competence. As Sylvia Charp argues: "It is generally agreed that more still needs to be done in faculty development if we expect truly broad use of technology in teaching and learning to occur." Any plan we develop to better prepare of education graduates must include a technology mastery component designed for our education faculty.

Clearly, many of us are becoming aware that prospective teachers need additional training in educational technology. But how technology competent are America's experienced teachers? Len Scrogan points out that "the vast majority of teachers today have little or no training in the use of the new technologies."[3] It is tempting to appease ourselves with the thought that although education graduates are not prepared for technology use, neither are their future colleagues—the inservice teachers. If the majority of experienced teachers are not able to use computers instructionally, how important can technology competence be for beginning teachers? However, if we believe our education graduates will gain necessary technology skills through "on-the-job" training, we may be deluding ourselves.

Some on-the-job computer experiences may occur, but many schools feel they cannot afford the price of providing costly computer training for their staffs. Instead, districts are adopting cost effective approaches to solving the problem of increasing the technology competence of their staffs. In a 1989 open letter to SUNY Chancellor Bruce Johnstone, Long Island Superintendent of Schools Henry P. Reed stated that his district plans to "employ teachers and administrators only if they demonstrate computer literacy (in word processing, spreadsheets, graphing, and data bases). Candidates who have this technical training will be hired; those who do not face rejection."

Of course, it is impossible to get "on-the-job" training if you can't get the job! The ability to use technology effectively is rapidly becoming an important prerequisite for finding a teaching position. Computer competence *is* an important skill for all graduates. Are the education majors developing this competence in their pre-service programs? Are our education majors developing the necessary computer competence on their own? Is there a need for formal educational competence instruction? During the Fall semesters in 1989 and 1990, the elementary education majors at SUNY College at Buffalo were surveyed to determine their current levels of technology competence.

Conceptual Framework

The study was undertaken to clarify the extant state of technology competence of the elementary education majors at SUNY College at Buffalo. It was hoped the data gathered during the study would end speculation regarding the students' technology competence levels and help ensure that plans based on the actual needs of the students are developed to address the situation.

Some individuals claim that education majors are gaining the necessary technology skills from pre-college instruction, or on their own initiative, or even from courses offered by other departments such as computer science and technology. The study sought to confirm or deny those claims and to gather data upon which appropriate plans for addressing the situation could be based.

Methodology

In October, 1989, the 300 junior and senior elementary education majors (n=324) at SUNY College at Buffalo were surveyed to determine their current levels of computer competence. The survey was administered during class sessions of the students' methods courses. Respondents were guaranteed anonymity and all students participated willingly. The survey responses were recorded on standardized answer sheets which were machine scored. In October, 1990, and later in November, 1991, the study was replicated (1990, n=294; 1991, n=318) to ascertain any changes in their levels of computer competence.

Frequency distributions were obtained for each of the survey questions. (See the attached copy of the survey instrument listing the survey findings. The figures for the 1989 study are listed first in plain text digits, the 1990 results are listed second in *italicized digits*, and the 1991 results are listed in bold faced digits to help differentiate the three data sets. The reporting techniques are purely descriptive since the purpose of the study was to identify the computer competence levels of our elementary education majors. The study's findings were then used to develop a model for improving the technological competence of the elementary education majors.

Results, Conclusions, and Implications

The findings from all three studies are disturbing, but the last set of data show that the situation is clearly improving. Although the 1991 figures do indicate an improving situation, it is clear that there was still a great deal of work to be done. In 1989, nearly one-quarter (22%) of the students had *never* used a microcomputer—not at home, not at a friend's house, not in school, and not in college. By 1991, the proportion of students who had never used a computer had dropped to 19%. Ten years ago, those findings would not have been surprising, but, in the 1990s, they are cause for particular concern.

Some results are more encouraging, however. In 1989, more than two-thirds (68%) had never used a microcomputer in any college course. As a result of new programs that students were offered, that figure dropped to slightly less than one-third (31%) by 1991. That is a significant improvement, but it is still unacceptable. We know that students tend to model the methods they were taught; appropriate instructional use of technology was not part of the model that 31% of them experienced.

In 1990, more than half of the students (53%) rated their ability to use the microcomputer as a productivity tool as either "Low" or "Nonexistent." By the 1991 survey, only 11% of the students reported that they could not even use a word processor—still too many, but much improved. However, when they were asked about their ability to use other standard productivity tools like data bases and spreadsheets, the percentage of students with no experience increased greatly (42% could not use data base managers, 56% could not use spreadsheets, and 70% could not use charting software). These results reinforce Moursund's remark—we are still doing a miserable job of preparing our graduates for using computers.

Somewhat more comforting is the finding that students recognize the absence of technology training in their professional preparation and want to correct it. In 1991, three students in five (66%) rate learning to use the microcomputer more effectively as either "A Top Priority" or "Very Important" to them. Nearly all the students (91%) hope to have instruction that improves their use of the microcomputer. Education majors recognize their need to develop greater computer competence—even if the faculties of colleges of education are not providing them with opportunities to do so.

The present level of support for educational technology that many of our colleges of education are providing must change. The faculties in colleges of education across the country must insist on adequately preparing their graduates for the new demands of the teaching profession. Demonstrable computer competence is rapidly becoming a key consideration for teacher employment—as the open letter from Superintendent of Schools Henry P. Reed attests. We must explore ways to help our majors develop important technology-use competencies. At SUNY College at Buffalo, we are addressing the issue in a systematic fashion.

In the short-term—the 1991 academic year—we offered our undergraduate elementary education majors instructional computing "exposure," as part of their departmental education methods courses. These exposure sessions were provided as "show-and-tell" sessions, conducted by elementary education faculty and graduate assistants skilled in the educational use of technology. Students were introduced to the resources that were available to them—resources that they could access for themselves during the open computer lab hours.

In addition, education faculty were provided training sessions to increase their technological competence. These sessions were designed to help the faculty develop the expertise they'll need to teach their students how to integrate technology into their instructional approaches in the different content areas. Informal sessions were also arranged on a one-to-one or small basis for faculty who felt intimidated by the technology. At the same time, the elementary education majors were provided voluntary productivity tool workshop sessions to help them increase their levels of computer competence.

In the middle-term—by the Fall semester of 1992—we plan to provide an elective instructional technology course as one of our undergraduate offerings. This goal is achievable, at least partially, because of the involvement of the IBM Corporation in a study designed to improve the quality of elementary education in the state of New York. IBM has undertaken a statewide initiative in New York aimed at both K-6 and higher education settings. As part of the IBM New York State Initiative, the Elementary Education Department at SUNY College at Buffalo has received a fully equipped, networked computer lab with network copies of all of IBM's instructional software.

Because of our involvement in this IBM study, the Elementary Education Department now has the essential "cutting-edge" hardware and software needed to conduct an "Introduction to Educational Technology for the 1990s" course appropriately. With this computer laboratory as the training site, we will provide an elective course to help our majors use technology to enhance their professional productivity. A primary mission of the elective will be to help our education majors master word processing, data base management, spreadsheet manipulation, chart development, and telecommunications procedures to enhance their own productivity. In addition, we will also introduce students to methods for integrating these productivity tools into their classroom instruction. Eventually, we will explore the implications of requiring this instructional computing elective as part of our undergraduate program, making it a prerequisite for the methods courses.

Preparation of the type that this course will provide serves two purposes. First, it will give our education majors a solid foundation for further exposure to instructional uses of technology in content areas during their methods courses. Second, it will provide students with the skills necessary to compete in the "educational marketplace." The productivity skills that the students will develop in the course will help them enhance the effectiveness of their performance in all of their professional undertakings.

Finally, in the longer term, we are preparing our education faculty to integrate technology use within their methods courses. After students have acquired the necessary fundamental skills in the technology competence course, they must have opportunities to apply those skills in specific instructional settings for all the separate content areas. Those opportunities will result from the guidance that students are given during their educational methods courses. That guidance must be provided by a knowledgeable and competent education faculty.

Again, our involvement in the IBM New York State Initiative will ensure that our elementary education faculty have the necessary materials and training to that accomplish that goal. In addition, since IBM has provided a "partner" school in our area with a similar hardware and software configuration, we can ensure that our pre-service teachers will have the opportunity to practice teaching (during the "junior participation" experiences associated with their methods courses and during their student teaching semester) real students in technologically enriched classrooms with technologically competent supervising teachers.

If the plan is to achieve its goals, one critical ingredient is not yet determined. That element is the essential human factor—the willingness of the education faculty to devote the time and energy needed for them to master the instructional use of technology. Clearly, the necessary faculty commitment can be encouraged by appropriate administrative action. One such action certain to encourage faculty commitment is to make the instructional use of technology a key consideration in personnel issues including tenure and discretionary salary determinations. If faculty see comparable administrative support for adopting the instructional use of technology that they see for scholarship and teaching effectiveness, many of them will soon make the effort needed to master the technology.

The plan can achieve its goals if the education faculty will make the commitment necessary to make it work. It is time to improve the technological competence of our pre-service teachers. To help make that possible, we have formulated plans that address the present, the immediate future, and the longer term. All three phases of the plan are important for achieving the eventual goal of preparing students for their roles as teachers in the 1990's and beyond.

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1989-91 Buffalo State College Elementary Education Department Undergraduate Technology Competence Survey

1989 data are listed 1st in plain text digits
1990 data are listed 2nd in italicized digits
1991 data are listed 3rd in bold faced digits

1. Have you ever used a microcomputer?
   a) Yes 78% *82%* **81%** b) No 22% *18%* **19%**

2. Would you like instruction to increase your ability to use a microcomputer more effectively?
   a) Yes 94% *86%* **91%** b) No 6% *14%* **9%**

3. How important to you is learning to use computers more effectively?
   a) Top priority 10% *10%* **10%** b) Very important 51% *50%* **56%**
   c) Somewhat important 37% *38%* **33%** d) Not important 2% *2%* **1%**

4. Have you ever used a computer in a course at SUNY College at Buffalo?
   a) Yes 32% *46%* **69%** b) No 68% *54%* **31%**

5. Did you ever take a class where you were taught to use computers?
   a) Yes 52% *55%* **75%** b) No 48% *45%* **25%**

6. If you were taught to use a computer, at what level did the instruction occur? Mark all that apply.
   {Raw data, not percentages}
   a) Elementary 9 *3* **12** b) Junior High 11 *10* **18**
   c) Senior High 62 *57* **63** d) College 80 *85* **113**

7. Have you ever received *training* in computer usage as part of any course at Buffalo State College?
   a) Yes 23% *37%* **60%** b) No 77% *63%* **40%**

8. Have you received *training* in computer usage in any *education* course at Buffalo State College?
   a) Yes 13% *17%* **45%** b) No 87% *83%* **55%**

9. How would you rate your ability to use a computer *as a productivity tool* to help you work more effectively?
   a) High 6% *13%* **18%** b) Medium 31% *34%* **37%**
   c) Low 41% *39%* **34%** d) Nonexistent 22% *14%* **11%**

10. How would you rate your ability to use a computer as a *teaching tool*?
    a) High 4% *4%* **12%** b) Medium 16% *23%* **28%**
    c) Low 36% *42%* **35%** d) Nonexistent 44% *31%* **25%**

11. Do you own a microcomputer?
    a) Yes 17% *23%* **32%** b) No 83% *77%* **68%**

12. If you answered "No" to question 11, do you plan to buy a microcomputer in the near future?
{Raw data, not percentages}
a) Yes 65 *82* **93** b) No 187 *137* **117**

13. Do you now use a computer to help you complete class work?
a) Yes 29% *38%* **56%** b) No 71% *62%* **44%**

14. If you use a computer to help you complete your class work, which computer system do you use?
{Raw data, not percentages}
a) Apple II 30 *27* **52** b) IBM compatible 56 *69* **112**
c) Macintosh 1 *4* **19** d) Other 24 *30* **35**

15. Which of these computer applications do you use? (Mark all that apply)
a) Word processing 25% *14%* **64%** b) Data bases 6% *24%* **36%**
c) Spreadsheets 1% *1%* **10%** d) Charting 3% *11%* **21%**
e) None 67% *56%* **11%**

Paper (T3-06)

Incorporating Technology into Instruction: The Process of Designing Lessons

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Abstract

As computers and related technology have become accepted tools in the workplace and in the home, the public has pressured schools to make more use of technology in teaching and learning. Many educational leaders also have encouraged teachers to use technology. Teachers, however, have few guidelines or models that they can use to direct their efforts at incorporating technology into instruction. Their reluctance to use technology has been linked to a lack of proper training, yet the courses and workshops offered to teachers most often focus on developing their skills in using equipment.

This study examined the preparation processes four exemplary teachers used to design lessons that included the use of technology. The goal was to identify the features of this process as understood by the teachers themselves. The study revealed a process that includes phases and guiding principles. These guiding principles reflected teachers' beliefs and understandings about teaching in general and about technology in particular. Suggestions for teacher training that take the features of this process into account are offered.

A resolution adopted by the Association for Supervision and Curriculum Development (1989) notes that schools use technology less than other sectors of society, even as the need for the use of technology is growing more critical (ASCD, 1989). Inadequate training for teachers has been identified "as the most important ingredient affecting implementation of new technology" (OTA, 1988, p. 17). The integration of technology into teaching and learning will rely on teachers' abilities to use computers and other technology in ways that address instructional goals. Teachers, therefore, need training that complements the current use of software tools and instructional software (OTA, 1988), with less emphasis on technical skills and more emphasis on the process of determining how to use computers effectively and appropriately in instruction. Others (Schneiderman and Stecher, 1986; Stecher and Solorzano, 1987) have demonstrated that teachers need computer inservice training that helps them link the use of computers to the curriculum.

The goals and content of computer inservice, however, are often at odds with the movement toward the integration of computers into teaching and learning. Typically, introductory computer inservice workshops devote considerable time to hardware, mechanics of use, programming, and even the history of computers (Lintner et al., 1991). Much current training also fails to consider what teachers do in classrooms, and what they must know to be effective teachers. Little is known about the preparation process that precedes classroom activities that involve technology. Therefore, teachers have little knowledge to design their own instruction that incorporates technology. Practitioners and researchers agree, however, that more must be known about how teachers devise lessons in which technology is used before more effective inservice can be offered.

Teachers' Use of Technology

Research on teachers' use of computers in instruction is limited; even less is known about how they incorporate new methods and materials into their instructional repertoires. Many of the research efforts thus far have been directed at determining the effectiveness of computers as instructional devices, not at the ways that teachers use computers. Some researchers recognized the inadequacy of this approach early, and pointed to the need to examine the processes leading to the use of computers (Pea, 1985).

The Educational Technology Center (ETC, 1988b) investigated factors that influence teachers' decisions to use computers, and the influences of computer use on how teachers taught. Three factors were identified: teachers' knowledge of appropriate uses of computers; teachers' access to resources and support; and external forces that encourage or discourage use. ETC researchers found that specific reasons related to teachers' knowledge motivated teachers to use computers: a belief in the need to prepare students for the future, the computer's educational potential, and their own interest in computers. The most significant factor working against the use of computers was teachers' inability to see its potential benefit as outweighing the costs in time and effort to learn to use it. Regarding teachers' knowledge about computers, the important factors were the ability to link computer use to current classroom activities, and congruence with the teacher's customary classroom practices. Teachers perceived their use of computers as affecting their teaching style and classroom organization. They reported that when using computers they were more likely to use a variety of teaching techniques, and to use more inquiry-based strategies (ETC, 1988a; 1988b). Teachers reported that inservice training often did not prepare them to integrate computers into the curriculum and that they needed additional support materials to achieve integration.

Materials and inservice workshops are not the only significant factors in teachers' learning to use computers. Dweyer, Ringstaff, and Sandholtz (1990) observed that the ability to integrate computers into instruction occurs after teachers spend time using computers to support their existing methods of instruction. Sheingold and Hadley's survey (1990) found that teachers believed that using computers had changed their teaching practices. The teachers in the study believed that using computers allowed them to conduct classroom activities that had not been possible without the use of computers.

Another study from ETC (1988c), this one about the use of computers in guided inquiry, identified factors teachers considered when integrating computers into an existing curriculum. These were: congruence (fit with existing curricular goals), instrumentality (completeness of the new technology package), fit with existing practices, and fit with teachers' views of teaching and learning. The Office of Technology Assessment report (OTA, 1988) also noted that teachers who use technology first used it in ways that corresponded with their customary, and often traditional, methods of teaching. With continued use, however, these teachers began to experiment with other methods, and their teaching styles evolved to include more student centered, inquiry activities. Technology appeared to influence teaching in another way, allowing teachers to conduct classroom activities that were once impractical or even impossible.

Canning's study (1989) of educational innovators revealed similar patterns. The teachers in her study were the first in their districts to use computers. Ft with existing needs, values and practices was an overall theme in the reasons they gave for using computers. These teachers had created activity based classrooms, used many different objects and materials in their instruction, and continually planned for the incorporation of new ideas into their lessons. They viewed computers as personal tools.

Surveys of inservice teachers by Vockell and Jancich (1988) indicated that the most significant factor related to using computers in classrooms was the skill of the teacher. Although the content of inservice programs about computers is still debated, Sandoval (1984) found that the skills teachers developed in inservice programs usually were not linked to a unifying theme that was recognizable by teachers. The incorporation of a theme or framework, however, allowed teachers to relate the use of technology to what they already do in classrooms (Sutphin, 1987). A lesson learned from designing inservice for other innovations is that effective training must include strategies to use the innovation in instruction (Joyce, Hersh, and McKibbin, 1983; Joyce and Showers, 1985).

Cuban's (1986) study of teachers' use of media described the "practical pedagogy" of the teacher, in which the teacher balances the costs of learning to use a new device or strategy with the predicted return on the investment for the student from the new tool or technique. He found that teachers wanted tools that were simple, reliable, durable, and versatile. This tendency is supported by the techniques already present in teachers' repertoires and by the knowledge they have derived from teaching. Because of limitations in the school environment, teachers made situationally constrained choices about the efficiency of new tools—what Doyle and Ponder (In Cuban, 1986) referred to as the practicality ethic. Cuban gave several reasons for the uneven and limited penetration of technology into teachers' instructional repertoires: poor access to technology, flawed implementation, little knowledge from their own teacher education, and classroom demands.

Becker's (1987) survey measured teachers' perceptions and beliefs about the effects of computers on students. Teachers who used computers believed that this use offered students several benefits: motivation, cooperation and independence; development of higher order thinking skills; and mastery of basic skills. Most teachers reported that their teaching styles had not changed significantly with their use of computers. Some reported that with computers more peer tutoring occurred in their classrooms, but there were fewer changes in whole class instruction, small group work, or in seatwork. Becker's review of surveys, research reviews, and experimental studies (1990) concluded that research in this area so far offered little help to teachers about how to use computers.

Shavelson et al. (1984) attempted to identify characteristics of effective teachers who used computers in mathematics and science instruction, and to determine if patterns in computer use among teachers existed. They found four types of use based on: teachers' goals for computer use; the degree of integration into subject matter; and the extent of the variation among the types of software used by teachers. No difference in teacher attitude to computer use was found among the types of use. Furthermore, few teacher characteristics were related to the ways teachers used computers. The ways teachers used computers, for example, were unrelated to their experience in using computers, whether they had taught others to use computers, or to their experience in programming.

Foliart and Lemlech (1989) conducted a study based on Shavelson's design and found four clusters or patterns of use that were somewhat different from Shavelson's. They found that various aspects of the curriculum were related to these patterns of use: teachers' goals, subject matter, teaching strategies, grouping, and time spent at the computer.

Purpose and Method of the Study

The purpose of this study was to explore the processes teachers use to prepare instruction in which technology is used, and to identify the features of these processes as understood and experienced by teachers. To create a picture of what teachers know and do while preparing for instruction, I needed to discover the means by which their understandings and beliefs about the use of computers in instruction are incorporated into the design of lessons.

The participants in the study were four teachers, two males and two females, who had been identified through a nationwide search process as demonstrating outstanding leadership and achievement. They were selected for this award based on their innovative use of technology in teaching and learning. Two teachers worked at the high school level; one taught English in the general education program, and the other taught in the gifted program. The third teacher worked in an early elementary resource room for emotionally impaired students, and the fourth in a junior high technology education laboratory.

I interviewed and observed the teachers during a week-long visit to each teacher at his or her school and home. Three strategies—stimulated recall, thinking aloud, and process tracing—provided the means for the teachers to give me information during the interviews and discussions.

Results

The study showed that, although these teachers had not always used computers and related technology in their teaching, using computers fit into their existing processes for developing ideas. Their design of classroom events in which technology was used always occurred within, and as a result of, this tacit process. Although each teacher's process was unique, two distinguishable features—phases and guiding principles—were common to all the processes. The processes had several identifiable phases or stages. A set of beliefs about teaching, learning, and students, guiding principles, directed the processes.

Phases of the Process

The processes used by the teachers to design activities for classrooms appeared to occur in four phases: (a) collecting; (b) inquiring; (c) synthesizing; and (d) using. The phases in this design process overlapped; there were no clear demarcations between the end of one phase and the beginning of the next phase. The teacher began the process of designing lessons by first gathering ideas and information. As Ruth explained: "It's not something that ever quits. But I don't say, 'Now I'm planning.' It's an unconscious awareness of things that might be usable." Like the others, ideas for use in class occurred to Ruth at any time, although she might not have been conscious of it when it was occurring. She saw herself as constantly scanning the environment for useful materials. They all carried out this process of looking for ideas and materials constantly. George saw teachers' experiences as a library from which to draw ideas: "You never know when you can use what you pick up, when the little blocks, the jewels, will be useful."

At some point, the teachers acted on the ideas and materials they had collected. This event marked the second phase of the process—inquiring—where ideas for lessons start to become actual lessons. Ed, for example, "stumbles" on lessons by building ideas on questions the students ask, and then by "manipulating" objects associated with the idea. When he came up against a problem, he "thought about it pretty good." He played and experimented with the ideas, thereby gathering more information about them. "I experiment to keep coming up with something new, I work with my hands; maybe I think with my hands, manipulating physical things," he said.

After some time, the teachers synthesized the ideas they had collected and worked with into lessons. In this third phase of the process, ideas for lessons often occurred to them as flashes of insight. Caroline described how: "Two weeks ago in my telecomputing class, I saw the never ending story with modems and thought, 'I could do that without modems.'" Caroline's actions in class also depended on what she was doing outside the classroom. She tried to incorporate experiences from all parts of her life into classroom activities.

The ideas that had been developed into lessons and activities were finally used in the classroom; this occurred in the fourth phase of the design process. The teachers deliberately had not designed everything for the lesson. George put some pieces in place at the last moment, and he allowed other activities to grow out of what happened in a particular class. He said he leaves "25% undone so it can be spontaneous." He noted that being able to do this depended on experience and knowledge. If he leaves his plans general, he felt he would be forced to update them.

Similarly, Ruth had an image of what the outcome of a lesson would be, a general idea of an activity or project, but did not decide beforehand exactly *how* she would achieve the goal. She "grabs things" as she goes through the lesson, "on the fly," as she needs them. The teachers did not view the use of a lesson in the classroom as the end of the process; rather, they saw it as another occasion that would generate ideas for use in the next trial. If certain approaches did not work, Ruth tried different strategies the next time. As George tried his lessons, he found that some ideas worked but "some don't, and are quickly replaced."

Guiding Principles about Teaching and Technology

Certain beliefs drove the processes the teachers use to create lessons. These beliefs about teaching, students, and learning served as guidelines for the design process and its eventual outcomes, and were a product of the teachers' reflection on their teaching experiences. Each of the teachers had many guiding principles that fell into several categories: the teachers' goals for teaching in general, their goals for classroom events, beliefs about how students learn, beliefs about how teachers should teach, goals for what they want their students to experience in their classrooms, and subject specific goals. These guiding principles ranged from fundamental, overarching beliefs to specific beliefs about instruction in their content areas. The teachers used these beliefs to explain what they did, to themselves and to others. The guiding principles reflected the teachers' common concerns, although these concerns were manifested in different ways.

The teachers had defined their guiding principles further through their use of different forms of technology. In fact, a subset of guiding principles referred specifically to technology. Their guiding principles about technology were extensions of the overall guiding principles they held. The subset pertaining to technology contained categories of beliefs about computers: the effect of computers on them as persons and teachers, the effect of computers on students, the nature of computers, and uses of technology in specific subjects and grade levels. The teachers repeatedly used the phrase "it's [the computer] just a tool," to describe their orientation to the computer. They believed the computer fit into their existing approach to teaching, what they referred to as their teaching style or philosophy. Computers enabled them to fulfill their educational goals. They saw computers as one of many tools, as one object among a variety of others that could be used in the classroom. This belief provided an internal framework for their use of computers, and by acting on this belief they created the external conditions in the environment that encouraged and allowed more use of the computer.

For example, Ruth saw computers as both "tools" and "gimmicks," and wondered if the students' positive feelings about her class were partly due to the of use computers in the class. She was concerned, however, that although some instructional tasks could be done faster with technology, perhaps they should *not* be done faster. She felt, though, that students were not as comfortable with the machines as she was. For them, editing was quicker by hand because of their lack of keyboarding skills. She remained convinced that her students needed to learn to use computers: "They need to know what the computer can do for them." She believed technology could help her to reach more students: "[Computers] maybe makes it easier to learn. I can't provide for all needs.... Maybe different delivery systems help reach different learners."

For herself, the effect of using computers has been positive: "To me, word processing takes away 80% of the pain of writing." She has noticed that when she works at the computer she feels that after awhile, she "disappears into the screen. I like techie stuff, machines; I always had a techie orientation. I like it too because it's so nontraditional." Given her own feelings of success using computers, Ruth recommended that all teachers become "computer friendly" by learning how to do word processing and spreadsheets.

Ed's guiding principles also reflected his beliefs about the role of computers in teaching and learning. He, too, sees the computer as "just another machine," and that like any machine, the computer is another way to teach technology education. He believed that unless a teacher had three to four computer stations in the classroom, the technology would not be able to help the teacher. He only had one computer, and did not have a projection system to use for demonstrations; a CAD system did not work well in his classroom because he did not have enough machines. Ed believed it was difficult to use computers in his classes: "Use for me is inhibited by the physical setup at the school. Computers need a proper space, not in a lab." He still tried to integrate it into the technology education courses. Ed felt that his students needed to know about computers; it was "consumer knowledge" for the students. His goal in technology education was "computer exposure," and he often brought in his own computer and showed the students how to use it.

With respect to the effects of computers on him as a person and as a teacher, Ed observed "I used to think with a pencil, then a typewriter, now I use computers." He believed that the critical aspect of the computer is that people can interact with it. Teachers, he said, need to capitalize on this potential by integrating computers into what they already teach: "You have to figure out how you put it to work in the classroom. It's an ongoing process." Teachers could do this, he thought, if they had a model for the use of technology that they could change to suit their own needs, to reflect their own situations.

George's beliefs followed the same pattern. He saw a future society in which technology would be used in all aspects of life. Therefore, he felt he could serve his students best by preparing them to live in a technological society. "All the things I teach are related to a global, far-reaching dimension." He wanted them to leave his classes with the skill to solve problems by applying technological tools. To this end, he attempted to demonstrate a variety of specific uses of computers in all his classes. His students would be better prepared at all levels, he said, by using technology as tools.

Caroline's guiding principles echoed the others'. To her, the significant aspect of the computer was that it provided another "delivery system" for information. "Books or computers, they're just other ways to find information," she says. As with the others, technology was "just a tool, a way to extend the curriculum." She did not want to see "a break between the book and computer, but a nice blending." She also believed computers could help her to reach different learners: "maybe it makes it easier for them to learn.... It helps them develop skills in group work and in decision making. I can't provide for all their needs."

She saw the effect of computers on her students as positive; they usually wanted to use the computers. She noted that some of her students choose to stay in the classroom at recess and use a math drill program rather than go outside. She was dismayed, however, that much of the use she saw was limited to drill and practice programs. Caroline believed using computers helped her give her students the variety in method she felt was essential to their learning. For example, she had her students use computers to track letters. They also used several other noncomputer activities for this exercise: "Typing letters is just another way to do this. Computers are different for them. It's independence...The computer is a tool that helps because it gives variety."

Her ideal use of computers was one in which teachers and students use computers in an integrated way in a variety of subjects simultaneously. In this type of use, the students had a genuine purpose for using the computer, and used the computer along with video tapes, books, and other material. She preferred clusters of computers in a classroom so groups of students could use them together. In whatever way she used technology, Caroline wanted "to make sure things are right for the children."

These teachers began their exploration of computers with preexisting, general, guiding principles. During their exploration of computers, they developed specific guiding principles about technology. These new ideas resulted from continuous exploration and were constantly updated. There was strong agreement between the general and specific sets of guiding principles. For example, Caroline wanted to provide variety for her students. Thus, she had added computers to her own process of design, because they provided variety for her students. In this way, the technology subset enabled the goals of the larger set of guiding principles to be fulfilled. The set of principles related to technology were not fully formed at the initial discovery of the computer or any other device; these beliefs were refined after repeated trials in the classroom.

Conclusions

The results of this study support the findings from other studies (ETC, 1988a, 1988b, 1988c; Canning, 1989; Sheingold and Hadley, 1990; Stecher and Solorzano, 1987) that fit with existing practices increases the likelihood that teachers will use technology effectively. This study suggests that an important part of that fit occurs at the preparation level, while teachers create the lessons, and at the level of the beliefs that drive this process. It is beyond the scope of this study to create models for teachers' design of lessons. Several findings from this explication of the design process, however, can be used to construct these models, and to design teacher training for the use of technology.

This study showed that these teachers used a common process—both complex and highly individualized—to create lessons, including those lessons in which technology is used. They used it because it worked; it led them from an initial idea to a lesson. They were able to apply this process, without conscious effort, to the design of lessons that included the use of computers.

Suggestions for Inservice Education

Because of the flexible and open nature of this process, it would be antithetical to design training experiences and materials that encourage teachers to follow a standard procedure for designing classroom use of technology. Rather than imposing a standard model of lesson development on teachers, teacher educators can help teachers develop unique design processes. In this way, teachers will incorporate the use of technology into what they already do, into what teachers often call their teaching style or teaching philosophy.

As shown in previous research, the teacher who is learning about using computers might be more likely to integrate technology into what he or she is doing in class if new knowledge fits within an existing framework, one with which the teacher is already familiar. Inservice instructors can help teachers discover their own particular forms of this process.

Teachers' overall educational goals, in the form of guiding principles, influence their design of lessons. As they discover more about technology by using it, they add more beliefs to the original set of guiding principles. They apply the entire set of guiding principles when designing technology lessons, not only those principles about technology. The use of technology enables them to realize long-standing educational goals; these goals influence their choices about when and how to use technology. To the degree that technology enables their guiding principles to be realized, it is used; personal preferences mediate the process of deciding how and when to use technology.

Those who design and provide inservice can build on what is known about teachers' design of lessons. They can focus on the fact that teachers develop their beliefs by using technology, and that new beliefs are extensions of initial beliefs about teaching and learning. Teacher educators can construct useful technology training for teachers by helping teachers become aware of their overall beliefs about teaching and learning, and to see how these beliefs will affect the ways they use technology and the attitudes they will develop about technology.

The teachers in this study thought critically about using technology. Technology was not at the center of the image that prompted a particular lesson. They did not use computers in isolation from other materials but along with other tools; computers did not take precedence over other objects. Each of them had made the personal discovery that computers could help them as teachers. They had found ways to integrate technology into their teaching; in this way, it had become another instructional tool. The teachers in this study viewed computers as a potential tool for all subject areas and grade levels, as "just another machine."

They saw its effect as changing the dimensions of teaching from local, bounded by classroom walls, to global, with no boundaries. They believed that computers also made it possible for them to reach more students, and to prepare their students. These results underline the importance of linking what teachers do with computers to what they already do as teachers, and suggest that teachers' thoughts and actions before a classroom event are critical to their effective use of technology.

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Paper (T3-06)

Mathematical Software as an Exploration Tool

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Abstract

LETSMath and GeoBlock are mathematical software tools currently being developed for classroom use. LETSMath focuses on calculus and GeoBlock on geometry. The objective of these two packages is to realize attractive and exciting lessons that are impossible without a computer. The main features of both of the packages are introduced, and descriptions of experimental lessons are given using LETSMath and GeoBlock.

Introduction

Traditional mathematics lessons consist mainly of lectures, drills, and problem-solving exercises. However, this type of lesson is not necessarily attractive for all students. On the other hand, a science lesson often includes experimentation. In experimentation, students predict the result of an experiment and examine whether their prediction is true or not. Alternatively, they collect experimental data and induce a certain rule from the data. Most students seem to find these processes enjoyable.

We think that, by using a computer as a tool, mathematics teachers can also conduct such "experimentation" in their lessons, thus making them more attractive and exciting for students who do not like mathematics.

We are therefore developing two mathematical tools to be used in classrooms. One called LETSMath is for calculus, and the other called GeoBlock is for geometry. These two programs were initially designed to offer students "experimental instruments" for learning mathematics. However, we believe that it is also possible for teachers to use them as presentation tools.

We intended both LETSMath and GeoBlock to have a good user interface, because most high school teachers and students are not computer specialists. For this purpose, we developed a special front-end processor called the Mathematical Formula Editor (MFE), so that a user can enter formulas in the same form as that in which they appear in textbooks.

Recently, several mathematical software packages such as LETSMath and GeoBlock have been developed. Mathematica [1], Theorist [2], and Milo [3] are similar packages to LETSMath, but they are intended mainly for university-level calculus, whereas LETSMath is intended mainly for high-school calculus. Therefore, although they have more functions than LETSMath, they are not necessarily easy for high-school students to use.

Moreover, the animation functions of these packages are *not interactive* because they save several graphs beforehand and display only those graphs continuously, whereas LETSMath can transform graphs *interactively*. Like LETSMath, Mathematics Exploration Toolkit (MET) [4] is a package for high-school mathematics. However its operations are command-based, whereas those of LETSMath are menu-based. Furthermore, it does not have an animation function.

Geometric Supposer [5] and Cabri-Geometry [6], like GeoBlock, are software packages that can be used in high-school geometry lessons. However, the first does not allow students to manipulate geometrical figures as they wish, and the second requires a lot of work from students in order to construct figures.

We believe that all of the above packages involve various problems that remain to be solved, especially with respect to their use in high-school mathematics lessons.

Mathematical Formula Editor

One problem with traditional software for mathematics concerns the representation of mathematical formulas. For example, in the BASIC language, the sign '^' is used instead of a superscript to indicate an exponent and the keyword *SQRT* is used instead of square root expression. It is not *educative* for students to use formula expressions on a computer that are different from those they see in textbooks.

For this reason, we developed the Mathematical Formula Editor (MFE) [7]. The MFE enables a user to enter mathematical formulas in the same form as that in which they appear in a textbook. It can also display in the standard textbook form a formula obtained as a result of calculation.

Figure 1 shows an example of the key input processes of the MFE. A user can enter a mathematical formula with structures peculiar to mathematics, such as fractions or square roots, from a keyboard. Such structures are assigned to function keys. The mathematical structures can be nested. As a result, the user can enter a very complicated formula such as a standard distribution function. Since it is possible to locate the cursor at any position by clicking a mouse, the user can easily modify a formula.

LETSMath and GeoBlock include the MFE module as a front-end processor. Therefore both programs realize a good user interface with formula expression.

LETSMath

LETSMath is an acronym for "Learning Environment for Teachers and Students for Mathematics". It is a tool-type software package mainly for high-school calculus [8].

Using LETSMath, a user can draw graphs of input formulas, move a graph dynamically, and calculate formulas. The main features of LETSMath are as follows.

Graph-Drawing Function

After entering a formula by means of the MFE, a user can draw a graph of the formula simply by selecting the *Draw* menu. The user can change the scale of the graph interactively. It is possible to superimpose several graphs.

Animation

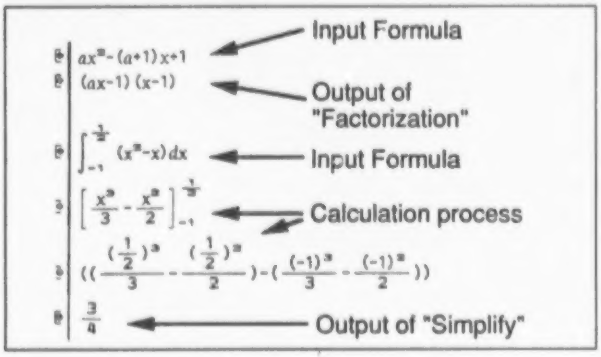
The animation feature is the most powerful function of LETSMath. A user can select the *Animation* menu for an input formula that includes several parameters, such as y=ax^2+bx+c. In this case, all the parameters are initialized with the values 1.0. The user can change each value by manipulating the *Parameter Panel*, and can observe the change in the shape of the curve *interactively*.

It is also possible to leave traces of curves by setting the *Strobe Mode* on (see Figure 2).

Formula Processing

LETSMath has basic formula-processing functions such as "simplify", "factorize", and "differentiate". Figure 3 shows some examples of these functions.

A user can also define a function or a variable. Once a function f(x) has been defined, it is possible to refer to its differential as formula f'(x).



$$ax^2-(a+1)x+1$$

$$(ax-1)(x-1)$$

$$\int_{-1}^{\frac{1}{2}}(x^2-x)\,dx$$

$$\left[\frac{x^3}{3}-\frac{x^2}{2}\right]_{-1}^{\frac{1}{2}}$$

$$\left(\left(\frac{(\frac{1}{2})^3}{3}-\frac{(\frac{1}{2})^2}{2}\right)-\left(\frac{(-1)^3}{3}-\frac{(-1)^2}{2}\right)\right)$$

$$\frac{3}{4}$$

Figure 3. Example of Formula Processing

Session File

A user can save and load an entire environment of LETSMath, including formulas and graphs.

This function, which we call *Session File*, helps teachers to prepare their lessons. It is also possible, we believe, to make a teaching material database by collecting these session files. A person using such a session file can also modify the contents simply by changing parts of the loaded formulas. This means that the teaching materials are very *flexible*.

GeoBlock

GeoBlock is a tool-type software package for high-school geometry [9]. It enables a user to draw geometrical figures, to set constraints on the figures, to change the shapes of the figures while preserving the constraints, and to observe geometrical characteristics.

Drawing Function

A user can draw basic geometrical figures, such as points, segments, circles, triangles, and polygons. To draw a figure, the user simply specifies the control points (points that define a figure, such as the two end points of a segment) by using a mouse.

Geometrical Constraints

Geometrical constraints are the most important concept in GeoBlock.

A user can set geometrical constraints on figures to be drawn and, by direct manipulation, can change the shapes of the figures while preserving the constraints. Constraints are set to the control points that define the figures. The main types of constraint are as follows:

1. At another control point (Link)
2. At an intersection of two lines, two circles, or a line and a circle (Cross)
3. On a line or a circle (On)
4. At a point located on a segment and dividing it in a given ratio
5. At a point where a tangent touches a circle

Block File

The figures constructed under geometrical constraints can be saved as *Parts* and be re-used in other figures. A student can enjoy the construction process in the same way as he or she might enjoy playing with a block toy.

Value-List

Each control point can be labeled with an letter of the alphabet (in the default setting, the "Automatic Label" mode is on).

By referring to these labels, and entering formulas with the MFE, a user can examine geometrical characteristics (such as length, angle, area, or ratio) numerically (see Figure 4).

Animation

GeoBlock can show a user the process of transformation of the figures continuously. This function allows a student to examine general characteristics of drawn figures visually and dynamically. It is also possible to leave a trace of the figures drawn in this process. Figure 5 shows the trace of two segments CD and DE, where C is a fixed point on the circle A, D is a moving point on the arc, and the angle CDE is fixed.

Session File

In GeoBlock, as in LETSMath, a user can save an entire environment, including figures and formulas. The use of the function is the same as in LETSMath.

Experimental Lessons

We now describe two experimental lessons where LETSMath and GeoBlock were used as exploratory tools. Both lessons were hold at Kita Junior High School in Hakodate City. In these lessons, each computer was shared by three or four students.

Experimental Lesson using LETSMath

This lesson was given by Mr. Yoshino. In the previous few lessons, students had already used LETSMath in order to familiarize themselves with it.

The objective of the lesson was, by using the animation function, to find the formula for a line symmetrical about the Y-axis with a given line.

The actual operations were as follows:

1. They drew the graph of y=-2x+3 on the system. (That is, they enter the formula y=-2x+3 and then selected the *Draw* menu.)
2. They enter the formula y=ax+b, and selected the *Animation* function. (The animation function was then invoked, and the *Parameter Panel* appeared.)
3. They manipulated the *Parameter Panel* so that the *moving line* became symmetrical with the line expressing y=-2x+3 (see Figure 6).
4. If they could find the required line, they recorded the values of parameters a and b. (In this case a was 2.0 and b was 3.0.)
5. They repeated operations 1 to 4 for several formulas expressing lines.

After these operations, students were able to induce the general rule, namely, that the formula of the line symmetrical about the Y-axis with the line y=ax+b is y=-ax+b. This shows that LETSMath can be used as a tool for helping students to induce a mathematical rule. The results of questionnaire on this lesson were also very favorable.

Experimental Lesson using GeoBlock

This lesson was given by Mr. Suzuki. The objective of the lesson is to find some characteristics of the figures.

With GeoBlock, it is very easy to transform figures that have already been drawn. Therefore, students can easily obtain many variations of figures with common constraints. This is why the teacher used GeoBlock in the lesson.

Students draw figures as follows (see Figure 7):

1. They drew an arbitrary triangle (ABC).
2. They drew three equilateral triangles (ABF, ACI, BCL), each with sides equal to one of the sides of triangle ABC. In this step, an equilateral triangle that had been previously saved as a block was re-used. The "at another control point" (*Link*) constraint was used so that both the arbitrary triangle and the equilateral triangle have a shared side in each case.
3. They drew a quadrilateral (AFLI) by connecting a vertex of the first triangle, A and a vertex of each of the equilateral triangles, F, L, and I.

Here, the problem was to determine what type of a quadrilateral AFLI is.

After they transformed these figures several times, the students made hypotheses intuitively. Some students had an idea that the quadrilateral might be a parallelogram, and others that it might be a rhombus.

Afterward, by using the Value-List, the students examined whether their hypotheses were true or not.

This lesson, as well as the lesson described before, would not have been possible without a computer.

Conclusion

Our objective is to make tool-type software that offers the possibility of new attractive lessons for mathematics. As we explained in Section 5, both LETSMath and GeoBlock have realized this objective to some extent, although there were some practical problems (for example, it took a few extra lessons for the students to become accustomed to these tools). We plan to improve these tools, while keeping in contact with mathematics teachers.

Acknowledgments

We wish to thank Mr. Ise, Mr. Yoshino, and Mr. Suzuki of Kita Junior High-School. They not only thought of ways to use LETSMath and GeoBlock in the classroom, and gave experimental lessons using them, but also gave us much useful advice on both of the packages.

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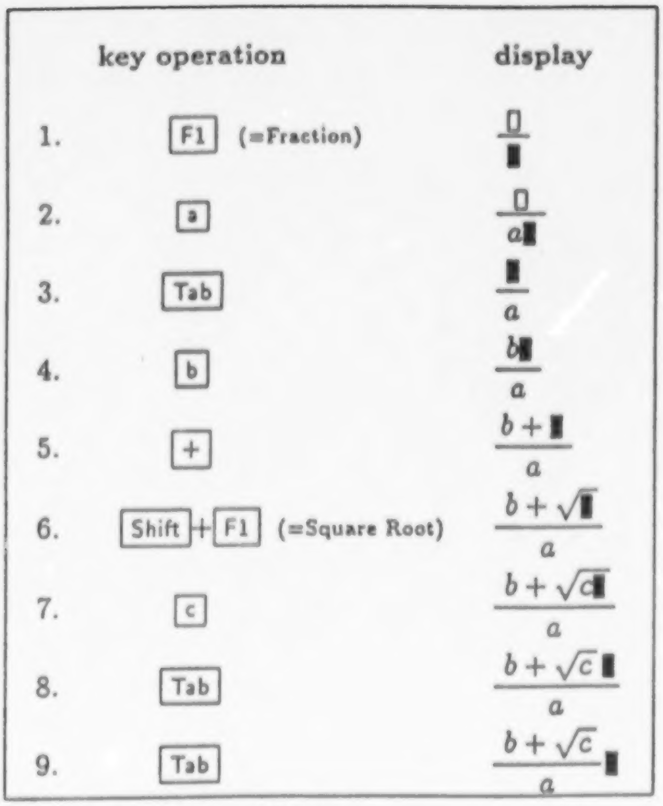
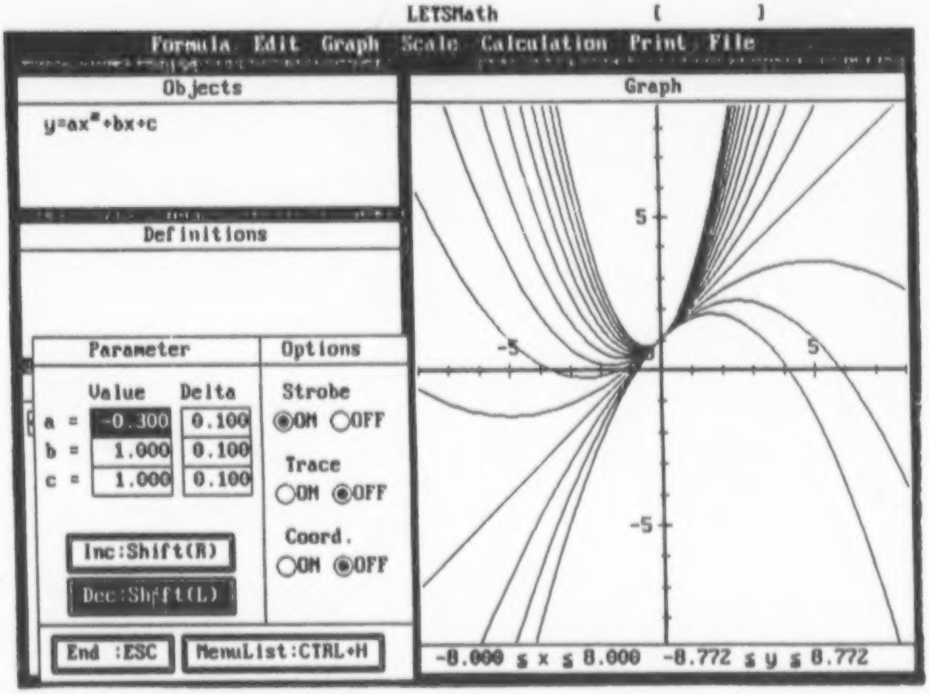


	key operation	display
1.	F1 (=Fraction)	$\frac{\square}{\blacksquare}$
2.	a	$\frac{\square}{a\blacksquare}$
3.	Tab	$\frac{\blacksquare}{a}$
4.	b	$\frac{b\blacksquare}{a}$
5.	+	$\frac{b+\blacksquare}{a}$
6.	Shift + F1 (=Square Root)	$\frac{b+\sqrt{\blacksquare}}{a}$
7.	c	$\frac{b+\sqrt{c\blacksquare}}{a}$
8.	Tab	$\frac{b+\sqrt{c}\,\blacksquare}{a}$
9.	Tab	$\frac{b+\sqrt{c}}{a}\blacksquare$

Figure 1. Formula Input Process


LETSMath [ ]
Formula Edit Graph Scale Calculation Print File
Objects
Definitions
Graph
Parameter
Options
5
-5
-5
5
Inc:Shift(R)
Dec:Shift(L)
End :ESC
MenuList:CTRL+H

y=ax²+bx+c

	Value	Delta
a =	-0.300	0.100
b =	1.000	0.100
c =	1.000	0.100

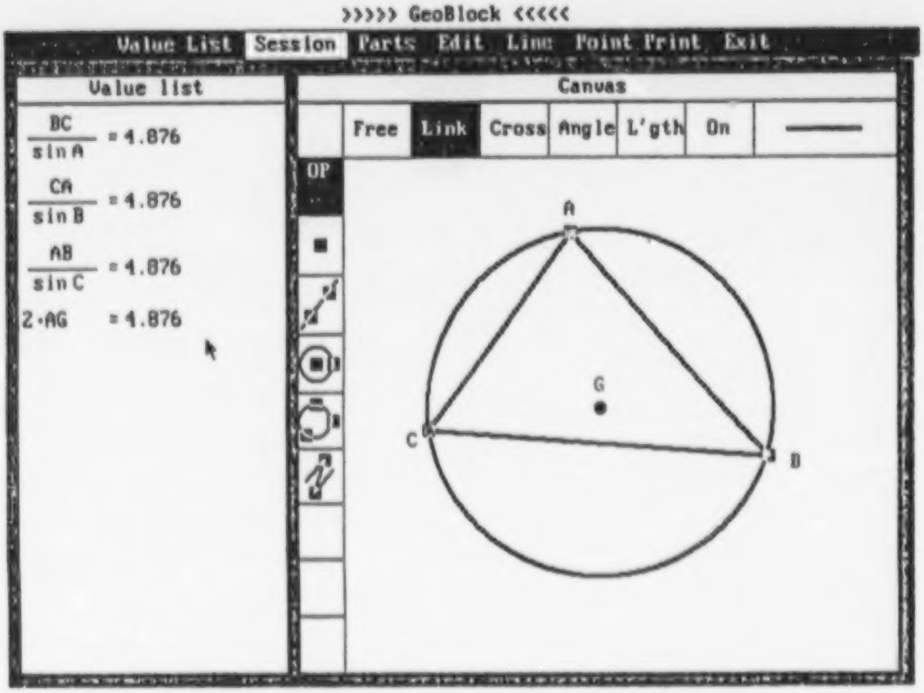
Strobe ●ON ○OFF

Trace ○ON ●OFF

Coord. ○ON ●OFF

$-8.000 \le x \le 8.000 \quad -8.772 \le y \le 8.772$

Figure 2. Animation of LETSMath


>>>>> GeoBlock <<<<<
Value List
Session
Parts
Edit
Line
Point
Print
Exit
Value list
Canvas
Free
Link
Cross
Angle
L'gth
On
OP
A
G
C
B

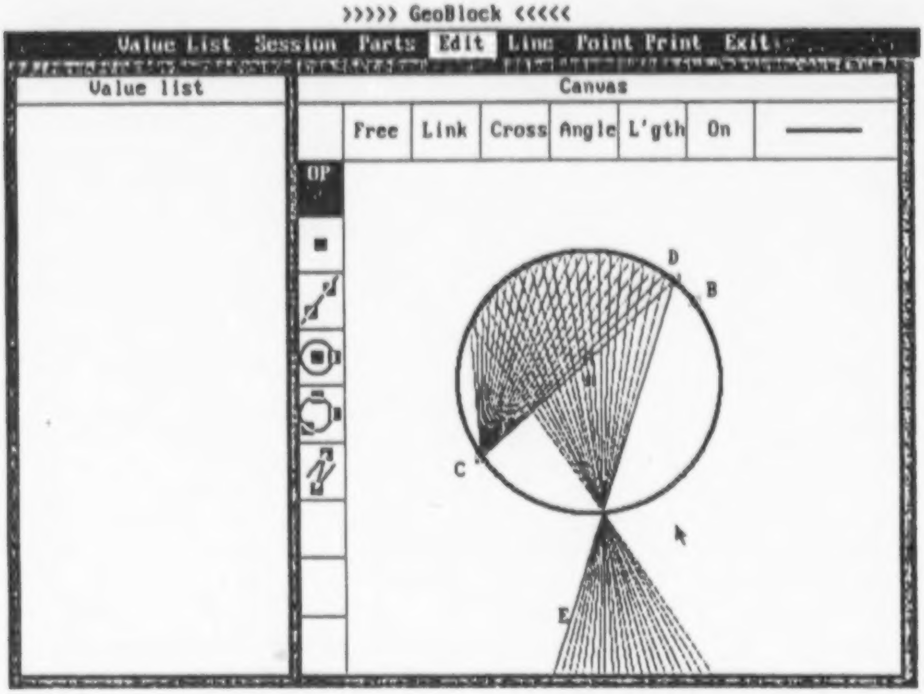
$\frac{BC}{\sin A} = 4.876$

$\frac{CA}{\sin B} = 4.876$

$\frac{AB}{\sin C} = 4.876$

$2 \cdot AG = 4.876$

Figure 4. Value-List Function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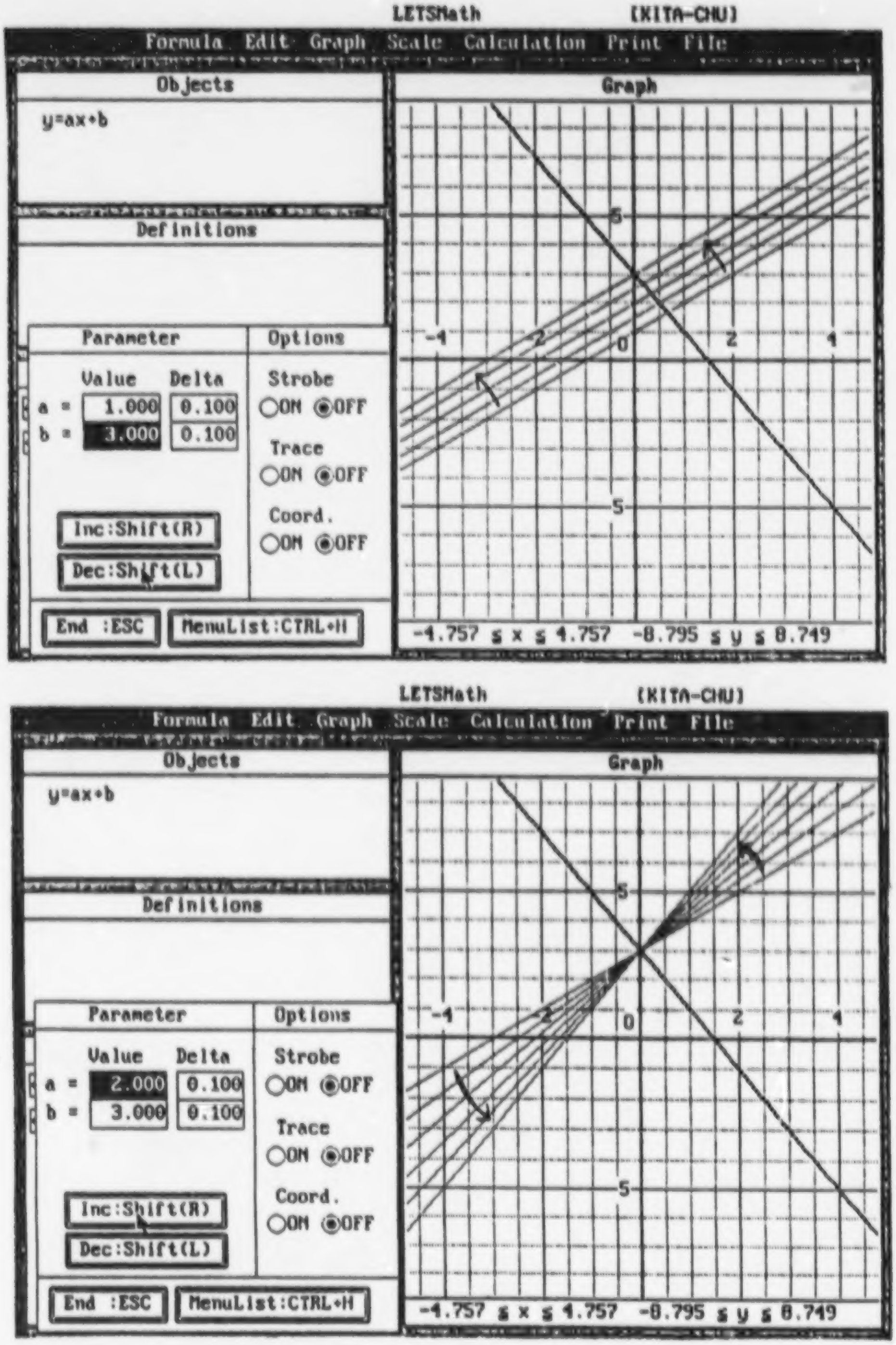
E

Figure 5. Animation of GeoBlock


LETSMath [KITA-CHU]
Formula Edit Graph Scale Calculation Print File
Objects
Definitions
Parameter
Options
Graph
Inc:Shift(R)
Dec:Shift(L)
End :ESC
MenuList:CTRL+H
5
-4
-2
0
2
4
-5

y=ax+b

Value Delta
a = 1.000 0.100
b = 3.000 0.100

Strobe ○ON ●OFF
Trace ○ON ●OFF
Coord. ○ON ●OFF

$-4.757 \le x \le 4.757 \quad -8.795 \le y \le 8.749$

LETSMath [KITA-CHU]
Formula Edit Graph Scale Calculation Print File
Objects
Definitions
Parameter
Options
Graph
Inc:Shift(R)
Dec:Shift(L)
End :ESC
MenuList:CTRL+H
5
-4
-2
0
2
4
-5

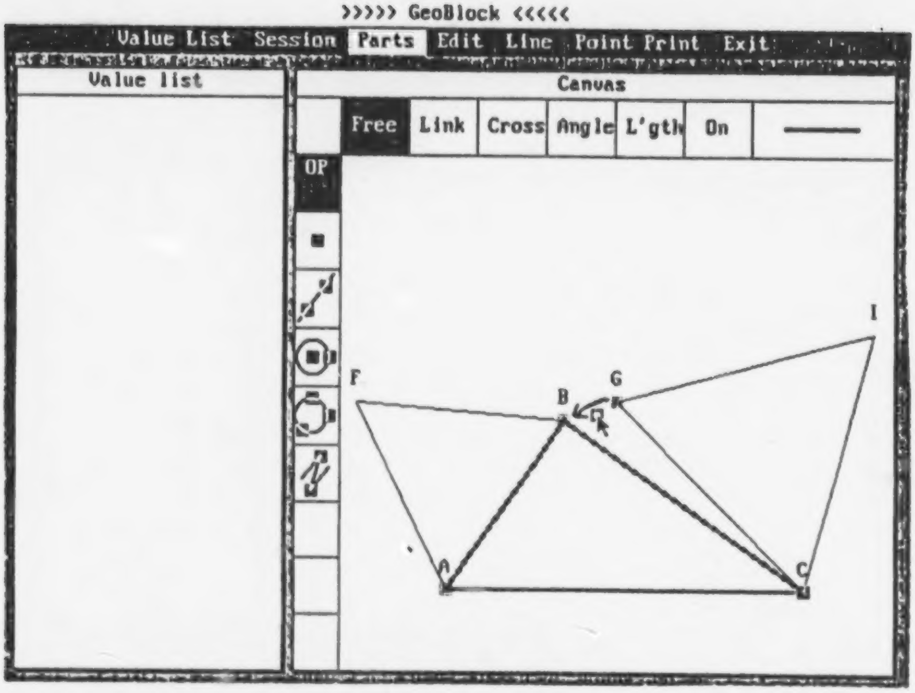
y=ax+b

Value Delta
a = 2.000 0.100
b = 3.000 0.100

Strobe ○ON ●OFF
Trace ○ON ●OFF
Coord. ○ON ●OFF

$-4.757 \le x \le 4.757 \quad -8.795 \le y \le 8.749$

Figure 6. Experimental Lesson Using LETSMath


>>>>> GeoBlock <<<<<
Value List
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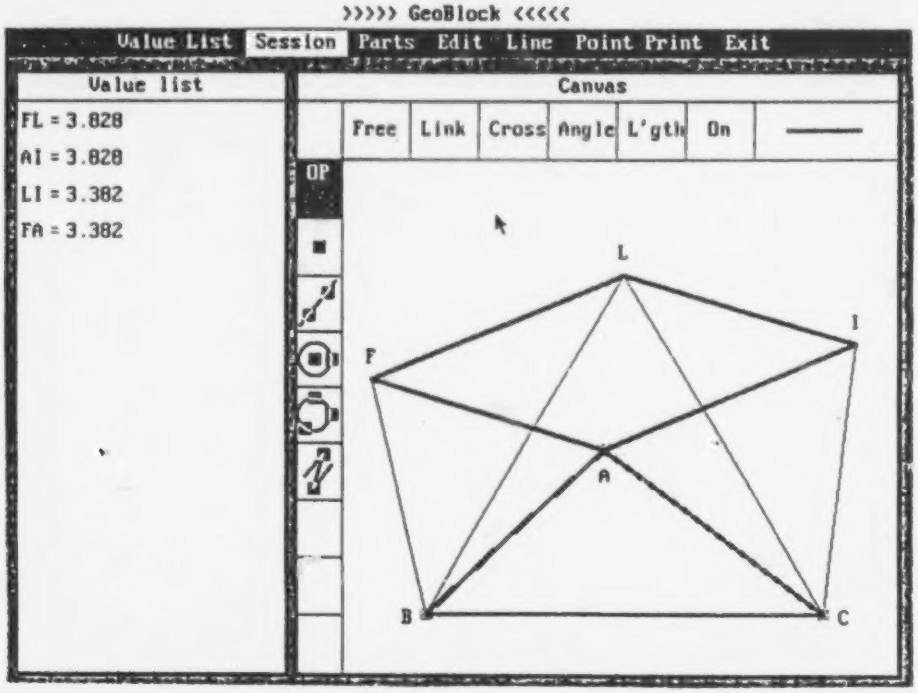
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I
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A
B
C

```
FL = 3.828
AI = 3.828
LI = 3.382
FA = 3.382
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Figure 7. Experimental Lesson Using GeoBlock

Special Presentation–ISTE (T3-07)

Teacher Researchers: The Logo Action Research Collaborative's National Sites Report

Abstract

The Logo Action Research Collaborative (LARC) is a national teacher enhancement network funded by the National Science Foundation. It supports Logo teachers to take on new professional roles, conducting action research projects and developing assessment tools related to Logo learning. Teacher researchers have conducted case studies of individual students' learning and investigated a broad range of research questions relevant to Logo learning environments. These have included: mathematical topics such as variables, recursion and the role of 360 degrees; pedagogical topics such as cooperative learning, facilitating sharing meetings, designing intervention strategies, involving students in assessing their own work, and using contracts to support pairs of students in resolving conflicts; and computer science topics such as structured programming, effective use of procedures and sub-procedures, creating images to support disk management; and debugging.

Workshops, papers and project presentations at NECC in 1987, 1988 and 1989 and 1991 have shared results from pilot projects, and from five of the National Sites. In this presentation the project directors will present the project overview and rationale, and share the experience of linking sites by telecommunication. Teacher leaders and a teacher participant from four sites will report on completed research by teachers and share the approaches they used to develop local support and carry on the project after national funding ended.

Presenters:

Daniel Lynn Watt and Molly Lynn Watt
Co-Directors, Logo Action Research Collaborative
Education Development Center
Newton, Massachusetts

Jack McKiernan
Teacher Leader, Logo Action Research Collaborative
Brattleboro Public Schools
Brattleboro, Vermont

Marian Rosen
Teacher Leader, Logo Action Research Collaborative
Ladue Public Schools
Ladue, Missouri

Phyllis Victorson
Teacher Leader, Logo Action Research Collaborative
Anshe Emet Day School
Chicago, Illinois

Nan Youngerman
Teacher Leader, Logo Action Research Collaborative
Madison Public Schools
Madison, Wisconsin

Donna Cutler-Landsman
Participant, Logo Action Research Collaborative
Middleton Public Schools
Middleton, Wisconsin

Special Presentation–Panel (T3-08)

ACM Curricular Recommendations for Two-Year College Programs

The Association for Computing Machinery (ACM) Two-Year College Computing Curricula Task Force is completing draft reports of curriculum recommendations for computer-related programs at two-year colleges. Four curricular areas have been investigated by Task Force subgroups. These areas are Computing and Engineering Technology, Computing Sciences, Computing for Information Processing and Computing Support Services. A fifth subgroup has been formulating recommendations dealing with Computing for Other Disciplines. Excerpts from each of the subgroup reports will be available for distribution. The following three project presentations will be made by members of the Task Force:

Computing for Information Processing and Computing Support Services

Joyce Currie Little
Towson State Univeristy
Baltimore, Maryland

Helene Chlopan
University of Kentucky
Lexington, Kentucky

Abstract

This presentation will discuss, compare, and contrast the two areas: Computing for Information Processing and Computing Support Services. Computing for Information Processing deals with job titles such as business applications programmer, programmer analyst, systems analyst, business analyst, database manager, and decision support systems specialist. Computing Support Services deals with job titles such as network controller, network technician, microcomputer support specialist, microcomputer maintenance specialist, desktop publisher, computer librarian, and computer equipment operator.

Computing and Engineering Technology and Computing Sciences

Karl Klee
Jamestown Community College
Jamestown, New York

John Impagliazzo
Hofstra University
Hempstead, New York

Abstract

This presentation will discuss, compare, and contrast the two areas: Computing and Engineering Technology and Computing Sciences. Computing and Engineering Technology deals with job titles such as CAD/CAM personnel, digital designer, electronics testing specialist, hardware developer, robotics technician, semiconductor specialist, and systems engineer. Computing Sciences deals with such job titles as database designer, knowledge engineer, numerical analyst, software developer, systems programmer, and security specialist.

Computing for Other Disciplines

Richard Austing
University of Maryland
College Park, Maryland

Therese Jones
Amarillo College
Amarillo, Texas

Abstract

This presentation will discuss the area of Computing for Other Disciplines. The objective of this area is to provide guidance for meeting the computing needs of students in disciplines other than computing. This guidance includes the following:

- Identify a range of courses a computing department may offer for students in other disciplines.
- Advocate that competency in a basic set of computing topics be part of the college's general education requirement.
- Specify topics that provide the computing knowledge needed by all students in two-year programs.
- Recommend a course, and it's prerequisites, that covers the essential topics in computing for all students.
- Delineate the commitments required of administrators and faculty in order to provide computing for students in other disciplines.
- Recommend the development of an assessment test for students placement in computing courses.

Projects (T3-09)
Classroom Activities for Students with Special Needs

Micro Mornings: A Gateway to Learning for Students With Special Needs

Christine Appert
Kluge Children's Rehabilitation Center
Charlottesville, Virginia

Abstract

This presentation will provide an overview of Micro Mornings, an enrichment program for elementary school-age children with learning disabililies and mild to moderate handicaps. Micro Mornings is sponsored by the University of Virginia Children's Medical Center and offers an intriguing sampling of organized small group activities during the summer and after school. Specifically, the Animal Safari project will be used to illustrate adapted computer-based experiences that take advantage of multimedia technology and integrated learning ventures.

The goals of the Micro Mornings program are to help students improve poor self-images, become more independent in learning tasks, take more responsibility for their own learning. Scaffolding activities assists youngsters in acquiring the ability to cope with the learning process, including its inevitable times of frustration, confusion, and difficulty. Technology offers a vehicle for accomplishing these goals and provides a valuable medium for the flexible and individual planning required in special education. "Learner-centered" software, videodisc applications, and other interactive media provide a dynamic and meaningful context for learning that accommodates individual learning styles and abilities.

Printer Power

Jamie Judd-Wall, Adaptive/Assistive Devices Consultant
Education Service Center, Region XIII
Austin, Texas

Abstract

Students feel successful when they are able to overcome a challenge. For students with learning problems, both identified special education students and those not yet identified but struggling to succeed in the classroom, productivity is a critical issue. Students are evaluated on what they are able to produce. Providing students with technological productivity tools increases the quality and quantity of student output. We will see videos of classrooms with multi-level productivity activities taking place. We will preview software and hardware used to increase student productivity.

The Young and the Restless: The Early Childhood Classroom

Julia Ringler and Kathy Coulter
Houston School
Denison, Texas

Abstract

Technology has changed the Early Childhood classroom. The classroom may physically have a different look, but the goal (successful children) remains the same. We would like to share with you some ideas that we have gathered, used, and found successful in reaching the 3-5 year old students who have a wide variety of handicapping conditions. Using slides, we will present to you both "high-tech" and "low-tech" suggestions for the following:

1. Including "ALL" children in daily activities.
2. Giving "ALL" children an organized system of control over their environments.

You will see ideas that can be incorporated into goals for language, motor, cognition, socialization and self-care. Included ideas utilize the following: keyboard adaptations, software selection, switch selection, switch placement, touch sensitive screens, loop tapes, cameras, environmental controls, communication through pictures, video usage, and the use of a "print-rich" environment.

Literacy Skills for Special Needs Children

Peggi McNairn
Burleson Independent School District
Arlington, Texas

Abstract

The purpose of this presentation is to describe an organized approach to teaching literacy skills to nonverbal, physically and mentally challenged individuals using adaptive, assistive technology. This approach utilizes teaching strategies which incorporate high tech and light tech devices to meet the unique challenges these individuals present. The strategies are intentionally generic in nature, enabling the parent or educator to use this approach with any reading curriculum or trade book. It incorporates the concept of concrete hands-on learning to stimulate abstract cognitive skills and to foster high interest in the learner. By utilizing the methods described by the author, language and cognitive skills can be developed and enhanced through voiced software, natural language interactions (conversation), and graphic symbols.

A review of the current literature available on nonverbal, physically challenged individuals revealed a distinct lack of information pertaining to the development of literacy skills in disabled persons. Informal interviews with parents and educators definitely supported the need for some kind of organized methodology for teaching this special population. As a result, the author developed a concise, easy to use document describing the use of specific techniques and devices that can be utilized at home and at school to deliver a systematic approach to teaching literacy skills. Much of the equipment is affordable and can easily be made with materials available through local stores.

Projects (T3-10)
Science

Technology Based Science Instruction

Greg Veal
Flower Mound, Texas

Abstract

Abstract not available at press time

A Project for Science and Technology Through a School/Business Partnership

Dee Goldberg
Spring Branch Independent School District
Houston, Texas

Abstract

A Project for Science and Technology Through A School/Business Partnership is a collaborative project involving a group of volunteer engineers from Bechtel Corp., students and teachers from Thornwood Elementary, and the Division of Instruction at Spring Branch Independent School District. This program developed out of the need for hands-on experiences in elementary science which support team building, future work issues, and the basic work force skill of problem solving.

The project uses Lego Logo building blocks, district produced curriculum materials, and computers to provide students with problem solving opportunities designed to build higher level thinking skills in an interdisciplinary environment. The pilot project, which lasted six weeks, allowed students in grades four and five to work with volunteers from Bechtel in a series of projects using Lego Logo building materials. Students worked with engineers to create mechanical turtles, cars, and other robots which were programmed to move and perform various tasks.

The program continues at Thornwood and has been expanded to other schools in the district. The combination of Lego Logo curriculum materials and the volunteer bank of engineers has proven to be extremely successful in encouraging students to become excited about science, math, and technology.

High Tech in the Phy Sci Classroom

Madeline Howard
McCullough High School–Conroe Independent School District
The Woodlands, Texas

Abstract

Science is a dynamic field of study, and the use of technology greatly expands the student's access to scientific knowledge. In particular, the physical science course contains many areas in which technology can be readily integrated. Students can study content as the principles of electricity, magnetism, light, and sound are demonstrated and applied using various apparatus. Experiments can be either simulated using software or can be monitored using auxiliary probes interfaced with the computer. Data from these experiments can be easily generated, arranged in a concise manner, and presented using graphics and word processing programs.

Additionally, technology allows the student and teacher to move away from traditional assessment methods and become more creative in the way that teaching and learning are accomplished. Video equipment allows students to record their manipulations which can later be edited and revised to provide a measurement tool that is every bit as accurate as fundamental testing measures. Technology further enhances creativity by managing many of the classroom procedures that impede educational progress. And most importantly, the use of technology provides a motivational tool for both the student and teacher, allowing them to both become excited about the part they play in the learning process.

This presentation will be an overview of how a physical science course was transformed using technology in a TEC Lab setting. Included will be specific lessons, organizational tips, equipment and software reviews, and examples of student products.

ECO NEWS–An Environmental Newsletter Created by Elementary Students

Sandra Cangelosi and Judy Padden
Cedar Creek Elementary School
Austin, Texas

Abstract

With Ecology as one of the topics studied by elementary students and with an emphasis on conservation and recycling at home and at the workplace, fourth grade students at Cedar Creek Elementary developed an environmental newsletter.

As an interdisciplinary unit with the computer class, applications for the unit included using word processing, data base files, telecommunications and desktop publishing.

Using the *Apple Works*, students wrote business letters to different corporations and local businesses giving concerns about their part in saving the environment. Students also thanked some businesses for their contributions.

After doing research, students used the word processor to write reports about different animals. Before typing the report, an animal fact sheet was completed giving general information, living habits, environment and other interesting facts about each animal. The data about each animal was then entered into a data base file using *Bank Street Beginner's Filer*.

In the regular classroom, students gathered facts about the environment, wrote poems and reports, and then typed the information on the word processor. The desktop publishing program *Pagemaker* was used for the layout of the first newletter.

Environmental tips, quizzes and surveys have been posted on TENET and students encouraged other schools to get involved in sharing information on the environment.

Creative ideas, factual information and surveys for the newsletter will be shared with the community and with other schools using telecommunications.

Projects (T3-11)
At-Risk Students

Alternatives for Teaching the At-Risk Student

Michael Eaton
Carrollton, Texas

Abstract

Abstract not available at press time

At Risk Students, Summer School, and Technology: Making It Work!

Sylvia Martinez
Middle School Computer Literacy Teacher
San Antonio, Texas

Nancy Robbins
Instructional Technology Coordinator
San Antonio Independent School District
San Antonio, Texas

Abstract

San Antonio Independent School district has developed a unique and innovative approach to summer school programs which serve the At-Risk population. Rather than the traditional remedial approach to curriculum which has been the paradigm of past summer school programs, the district has implemented a new paradigm involving technology as a key instructional strategy. The new program was piloted during the summer of 1991, and our project presentation will describe specific examples of one course taught and how teachers were prepared themselves.

The social studies/science/language arts course was conducted as an interactive course whereby the students developed HyperCard presentations as the vehicle for learning the required concepts.

Part of the innovative process involved the teacher preparation for summer school. Prior to students beginning class, the teachers attended staff development where they were taught the skills for using technology in the instructional process. Teachers had a week of training using Macintosh computers, HyperCard, a scanner, sound input devices, and multimedia techniques. The extrinsic reward for the teachers who chose to participate was a new Macintosh Classic and ImageWriter printer for each to take back to his/her own classroom in the fall.

The success of the initial project was such that plans are already made for similar courses to be developed for summer school 1992.

Looking Into and Looking Out from the Classroom's Electronic Windows

Sharon Kubenka
Ingram Elementary
Ingram, Texas

Margaret Riel
AT&T Learning Network
Encinitas, California

Abstract

Thousands of classrooms have joined Learning circles on the AT&T Learning Network and worked cooperatively with peers from around the world on interdisciplinary projects. This presentation will begin with an overview of the Learning circle model and the world of difference that students have discovered. The view will then narrow to a single Learning Circle and focus on one school in the Learning Circle — Ingram Elementary in Ingram, Texas. More than half of the school's 640 students are "at risk". Last spring the AT&T Learning Network was used with a select group of 3rd-6th grade students. Language Arts teachers compared writing samples and found that this experience led to improvement in writing skills. They also noticed an increase in student interest in writing. For the 1991-92 school year, all fourth graders, including the 20% diagnosed with language disorders, will be involved in the program.

After this overview, the angle of perception will be shifted to that of the classroom participants and their experiences in looking out. What do they see and learn from working with peers in different locations? In the fall, their Learning Circle partners will be from British Columbia, Spain, and throughout the United States. This experience and that of the spring 1992 session will be reported in this project presentation. The effects of working collaboratively with distant peers for both teacher and students will be discussed.

Let's Get REAL (Re-Educating Adult Learners))

Judy Yacio, Sharon Mallouf, and Joyce Ridings
Arlington Independent School District
Arlington, Texas

Abstract

Teachers at Berry Elementary School in Arlington, Texas have devised an adult literacy program from a multicultural perspective. Their solution to basic English-language literacy is a powerful, integrated program for adults that allows a multilevel reading program which combines reading comprehension, spelling, and writing. Emphasis has been placed on development of a practical sight vocabulary with concentration on both recognition and meaning of words.

In addition to using software already available to Berry students in the school's networked Appleshare lab, Project STAR from Hartley Courseware has been purchased with community donations. The faculty has also sponsored a garage sale with proceeds being used to purchase additional sound boards.

Direct instruction plus hands-on computer access to the school's 30 computers have excited the parent community and allowed adult students to be actively involved in their learning. Participants have been given homework assignments and are able to check out books from the school's library, enabling them to read when they are not in their classes which meet two evenings a week.

Projects (T3-12)
Restructuring Ideas

Rethinking Schools by "Planning Backwards" and Using Technology

David Niguidula
Brown University
Providence, Rhode Island

Abstract

School restructuring efforts and technology-in-education endeavors have typically moved along parallel tracks. Yet, both types of efforts are focused on creating new designs of schools that facilitate learning.

At the Coalition of Essential Schools, we have embarked on a project to se how technology can enhance at least one style of school restructuring.

International Business Machines (IBM) has provided funding and equipment to the Coalition and five partner schools for a study of "planning backwards". Each of the five public high schools in the project have been asked to create a vision of what it wants its students to know and be able to do upon graduation. From there, the schools are implementing "exhibitions of mastery." An exhibition is a performance, project, or paper that clearly demonstrates a student's mastery of some component of what the school considers essential. Ultimately, exhibitions can replace Carnegie units as the method of determining of a student is ready to graduate.

During 1990-91, the five schools (Eastern High School, Louisville, Kentucky; English High School, Boston Massachusetts; Sullivan High School, Chicago, Illinois; Thayer High School, Winchester, New Hampshire; Waldbrook High School, Baltimore, Maryland) defined and refined their visions of what their graduates need to be able to know and do, and what systems need to be changed to reach that goal. During 1991-92, the schools began to use computer technology to assist with this change. Among the uses of computer technology are:

- research stations to allow students to gain access to data and to fellow student-researchers
- local-area networks and telecommunications for teachers to share information about standards for student work (both within and among schools)
- presentation tools, ranging from word processors to multimedia and hypermedia, that allow students to communicate their ideas and demonstrate their mastery

While the schools are doing this work, we at the Coalition and at IBM are informing and disseminating their ideas. This project presentation will focus on the overall implications of the school's efforts and how technology can be useful for rethinking how schools work.

Improving Instruction Through Technology Integration–State and County Perspective

Dolores Burton and Lynn Reuss
Nassau County BOCES
Westbury, New York

Abstract

The Model Schools Program is a standard of excellence in implementing the goals and objectives outlined in the New York State Education Department's Long Range Plan for Technology in Elementary and Secondary Education. The philosophy of the program is to include planning, staff development, curriculum development, telecommunications, and evaluation into a comprehensive curriculum-driven environment to improve teaching and learning. The program is dedicated to improving understanding by training teachers to use technology to enhance the K-12 teaching and learning environment. Teachers receive instruction in tool software and curriculum integration and collaborate with peers to develop curriculum based lesson plans. These lesson plans are shared with participating districts in the county and state. In subsequent years, additional training is provided in sophisticated forms of technology integration and more complex lesson plans are created.

One of the key components of the program is the use of telecommunications for teachers and students to share information across the county and across the state. The Model Schools Program focuses on the use of the TNT Network, a statewide telecommunications link.

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Florida's Model Technology Schools: Four Years Later!

Mike Eason
Florida Department of Education
Tallahassee, Florida

Abstract

The purpose of Florida's Model Technology Schools (MTS) project is "to research and demonstrate the effective use of technology in instructional delivery and enhancement as well as school management." The partnership between the state, five school districts, universities, businesses, and parent and community groups is in its fourth year. Educational Technology Consultant, Mike Eason, will chair this panel. Joining him will be two Model Technology School facilitators. Together they will discuss how the schools are exploring effective ways to use the power of technology to better prepare their students for useful and productive lives. The presentation will share some of the project's accomplishments, failures, frustrations, surprises, and next steps. Events in the areas of implementation, evaluation, research and development, dissemination, staff development, and funding will be highlighted. Time permitting, the panel will take questions from the audience at the conclusion of the presentation.

Curriculum, Performance Assessment, Technology, and Restructuring: Making the Pieces Fit

Ivan Baugh
Jefferson Public Schools
Louisville, Kentucky

Donna Rehbeck
Ingham Intermediate School District
Mason, Michigan

Abstract

The student-centered, teacher facilitated classroom is one goal of school reform. If we can no longer expect students to "sit still while we instill," and if technology plays a major role in the restructured classroom, how do we make the transition? This presentation will explore new approaches to curriculum design, new methods of assessing student learning, and ways technology has been used in the new instructional paradigm.

Traditionally curriculum has been a static entity, often revised on a timeline that coincided with textbook adoption. Current technologies, new instructional practice and the information explosion have forced educators to view curriculum development as a fluid process. Projects in Jefferson County Public Schools and Ingham Intermediate School District demonstrate alternatives to traditional curriculum development. Staff development activities, field testing and revision of teacher developed curriculum, and an incentive program provide examples of new approaches tried in both districts.

Recognition of the need for students to apply knowledge and skills while performing tasks that demonstrate their learning exists as a part of most school restructuring literature. New technologies provide innovative means for students to present their learning as well as a tool for reducing the time spent on rote tasks, thereby increasing time spent on critical thinking. This presentation will provide samples of teacher developed, field tested learning experiences, students' performance assessments from an Environmental Science course, strategies from a district wide incentive program, and experiences learned from teacher shadowing in the business community.

Projects (T3-13)
Developing Cognitive Skills

Do We Teach Thinking Skills While Teaching Programming?

Mi Ok Cho
Korea Educational Development Institute
Seoul, Korea

Ann Thompson
Iowa State University
Ames, Iowa

Abstract

Guided Logo instruction, while teaching Logo programming, was used to help students develop cognitive monitoring strategies (CMS). Guided Logo instruction had three instructional elements: (1) using Logo as a learning tool; (2) modeling an explicit instructional design to activate CMS; and (3) applying mediated learning as teaching methods. CMS utilized in this project were as follows: decomposing skills, planning skills, executing skills, identifying error skills, and debugging skills. The classroom instruction involved two learning activities; Logo programming activities and everyday problem solving activities.

The guided Logo curriculum was applied and tested in an educational computing course for preservice teachers at Iowa State University. Through pilot tests for the development of the guided Logo curriculum, the manual for teaching CMS was refined and revised. In Fall semester of 1990, the curriculum was tested. Two female lecture instructors and five laboratory instructors taught the guided Logo instruction according to the Logo curriculum. One hundred and thirty-two preservice teachers enrolled in secondary education 101, entitled "Educational Applications of Computers," received the instruction. The project lasted four weeks with a total of 30 hours including lecture, laboratory work, and homework assignments.

Problem Solving Software: A Critical Database

Karen Swan, Anne Leversee, and Collete Richardson
State University of New York at Albany
Albany, New York

Abstract

The teaching and learning of problem solving skills has assumed critical importance in American K-12 education. One result of this change in priorities has been the proliferation of commercial problem solving software. Despite their potential usefulness, little has been done to systematically investigate these commonly available packages. In particular, little has been done to apply what we know about computers and problem solving to the evaluation of problem solving software. The project discussed in this presentation is a step in that direction.

This presentation will report on the design of a graphical hypertext form for the evaluation of problem solving software and the development of a ToolBook database of completed evaluations. A major consideration in the design process was devising a method for indicating whether various features of the software evaluated "short-circuited," "activated," or "modeled" the cognitive processes they proported to teach. Other design considerations were the organization of the evaluations within a hypertext environment and the presentation of sufficient evaluative information on a single ToolBook page.

The evaluation forms thusly designed are currently being used by inservice teachers to evaluate a variety of commercial problem solving software packages. The presentation will discuss that process and its findings concerning problem solving software in general and its potential usefulness in K-12 classrooms.

Learning Research Lab: S-Cubed (Sensory Syntonic Space)

Carin E. Horn and Jeff C. Bliesmer
Visual Learning Laboratory
Denton, Texas

Abstract

Announcing the super-high-tech S-Cubed Learning Research Laboratory—a prototype, experimental classroom for multimedia and telecommunications in which students program environmental light/color, sound, temperature, and ionization. S-Cubed (Sensory Syntonic Space) is CD-ROM based and incorporates various interactive technologies including the newly invented Topological Panorama Camera (Topocam), which is ideal for discovering spacetime relationships.

Although S-Cubed is interdisciplinary in nature, the current academic focus has been upon improving mathematics and science learning using the robotic Topocam system. Topocam's photographic images enable students to see the bit/space structure of mathematical/scientific events—events which are most frequently described numerically. Topocam photographs enable the student to visualize equations and formulas. (See Poster Session: Topological Panorama Camera for Pictographic Learning.)

The goal in developing the S-Cubed Learning Research Laboratory was to provide students with state-of-the-art access to electronic information and control over their learning environment. S-Cube's multifunctional space has the hypothetical potential to:

- impact the definition of *classroom*
- define environments that facilitate learning
- synthesize curricula, and
- enhance the ability to acquire and retain new knowledge.

The first S-Cubed Learning Laboratory is slated for fall construction in a rural community.

The Design and Implementation of a Multimedia Based Inquiry Program

Ronald Abate
Cleveland State University
Cleveland, Ohio

Abstract

Due to the high cost and time associated with the production of multimedia, few teachers are afforded the opportunity to design their own multimedia instructional materials. This presentation describes a pilot project in which a group of middle school teachers developed a set of multimedia inquiry lessons. These inquiry lessons were designed to encourge students to explain anomalous events by generating and testing hypotheses.

During the process of planning, designing and implementing the lessons, several observations were noted. Included among these observations were: 1) development requires considerable time, effort and technical skill; 2) access to legal video sources poses additional problems; and 3) the structure of the inquiry lessons changes the teachers role in the classroom.

This presentation will describe the steps required to create the multimeida inquiries and indentify some of the problems encountered by teachers/developers.

Special Window (T4-01)
Global Classrooms Through Telecommunications

International Telecommunications for Primary School Students: "A Show and Tell" of the Water Project

Moderators:
Gray Clayton
Waikato University
Waikato, New Zealand

David Moore
Sanger Independent School District
Sanger, Texas

Abstract

Students from around the world need to know the influence of water on their planet and their society. The Water Project is a study of the ways water is used around the world, including water treatment, recreational uses, effect on climate, and requirements for agriculture. Third and fourth grade students from the United States, New Zealand, and the United Kingdom investigated ways in which water influences their lives, both now and into the future. Students used the Internet and the DIALCOM telecommunications systems to share and compare data collected at various sites. This session will include a live demonstration of student activities.

Participants:

Nola Campbell
Waikato University
Waikato, New Zealand

Beverley Gower
Waikato Polytechnic
Waikato, New Zealand

Rhonda Christenson
Lamplighter School
Dallas, Texas

Nickie Weaver
Irion County Independent School District
Mertzon, Texas

International Student Exchanges: Using Telecommunications to Enhance Education in Science and Technology

John Southworth
University of Hawaii
Honolulu, Hawaii

David Moore
Sanger Independent School District
Sanger, Texas

(Other participants in the FAST–NEST Environmental Data Exchange Project)

Abstract

The International Network for Education in Science and Technology (NEST) seeks to increase global understanding of the environment and foster a global ethic of responsibility for nurturing that environment on national and international bases. A description of how NEST fosters science and technology education, and a demonstration of middle school student exchanges involving Lumaphone (slow-scan television) will be provided in this session. The use of integrated, multi-modal telecommunications techniques, such as simultaneous use of slow-scan television and electronic mail, will also be described.

Special Window (T4-02)
"Imaging" and Information Processing

Frank Papa
Texas College of Osteopathic Medicine
Fort Worth, Texas

Abstract

Decision makers require data. Visually-oriented "imaging" technologies provide "high density data" that can improve the likelihood that an accurate or optimal decision will be made.

The purpose of medical imaging technologies is to provide physicians with high density data. Selected imaging modalities will be presented along with a review of their specific applications. Following, will be a presentation which models (via a visually-oriented imaging approach), how physicians use data to arrive at diagnostic and therapeutic decisions.

ADAPT Spotlight (T4-03)

The New Unicorn "Smart Keyboard"–A Powerful Learning Tool

Arjan Khalsa
President, Unicorn Engineering, Inc.
Richmond, California

Abstract

Finally, a keyboard designed specifically to help children learn! You just plug it directly into any Apple IIGS, IBM/MS-DOS or Macintosh computer, slide in one of six colorful keyboard overlays and type on a surface geared just for the learning objectives of that particular program. Alphabetical overlays, numeric overlays, arrow keys only–this is a keyboard valuable for both special and regular education. Come learn more about it!

Special Presentation–Panel (T4-04)

Variations in Effectiveness of an Integrated Learning System

Henry Jay Becker
John Hopkins University Center for Social Organization of Schools
Baltimore, Maryland

Dwain Estes
Baylor University
Waco, Texas

Abstract

During the 1990-91 school year, Baylor University orchestrated a large-scale evaluation of a wide variety of implementations of the Jostens Basic Learning System across 25 school districts throughout the state of Texas. The implementations ranged from those of single classes in several districts to *all* students in 20 Chapter I schools in the Dallas school system. Altogether, the evaluation encompasses 48 ILS-using schools, 190 ILS-using classes, and 3,848 ILS-using students plus a similar number of comparison-group schools, classes, and students.

Each implementation was studied using one of several experimental or quasi-experimental designs, as appropriate to the conditions in that particular school or district being studied. For example, in many districts year-to-year gains in student achievement in one ILS-using school were compared with gains made by initially comparable students at other schools in the same district. In other districts, students within a school were randomly assigned to classes using math software and those using reading software. Owing to the large-scale nature of the study, outcomes studied were limited to standardized norm-referenced tests in reading and mathematics. On the other hand, data were systematically collected throughout the 25 districts concerning the conditions of each study, enabling an assessment of *variation* in effects—for example, enabling us to determine whether sites in their second year were generally more effective than those in their first year of use or whether sites using para-professional aides were as effective as those using certified teachers manning computer labs.

This symposium will present the results of this study—the largest study ever conducted of the achievement effects of integrated learning systems across a range of implementing conditions. The symposium will consist of six brief presentations followed by audience questions.

Dwain Estes, Professor of Educational Administration, Baylor University, will introduce the symposium. Dr. Estes is the director of Baylor University's Research, Evaluation, and Implementation Consortium for the Use of Integrated Learning Systems and is director of the Scholars of Practice doctoral program. It was through Dr. Estes' efforts that districts throughout Texas signed on to evaluate their ILS investments and that the data from these sites was gathered and organized for analysis.

Rosanne Stripling, Deputy Superintendent of the Waco, Texas I.S.D. and Project Director for this study, will discuss the methodology and general findings of the evaluation. She will briefly describe the research designs used and the source of the achievement data and then indicate the overall success of these implementations. It is important to note that the overall findings do not constitute either an endorsement or a condemnation of ILS use, but rather present a portrait of highly varying outcomes, which subsequent presentations in the symposium will illustrate and analyze.

Randy Albers, of the Midway I.S.D., will describe the implementation of ILS use and test score outcomes at a particularly successful site—one that showed substantial achievement gains in comparison to a matched group of students.

Barry Dodson, of Carrollton Farmers-Branch I.S.D., will discuss contrasting outcomes obtained in the Dallas school system, in which several distinct factors distinguished schools that were successful implementers from the larger number of schools that failed to produce substantially better test score outcomes among their ILS-using students.

Carrol Melnyk, K-12 Computer Coordinator in the Lubbock, Texas I.S.D., will present an initial meta-analysis of the achievement results, focusing on differences between how ILSes were implemented in the 25 districts and then showing the effects of those differences on student achievement. Her analysis will encompass "methodological" variables such as the research design and type of testing used; "setting" variables such as the demographic characteristics of students served and the nature of the school building; and "implementation" variables such as the duration of the school's ILS experience, the amount of ILS instructional time in each subject tested, and presence and characteristics of the lab attendant.

Henry Jay Becker, of the Johns Hopkins University Center for Social Organization of Schools, will discuss differences in ILS effectiveness for initially high-, average-, and low-scoring students. His presentation will argue that, based on differences in effectiveness for those groups of students, individualized systems of computer-based instruction need to be adapted to classroom-organized and teacher-based instruction. In addition, he will interpret the results of the findings presented by other symposium participants, and suggest how ILSes need to be implemented if they are to be cost-effective approaches to basic skills learning.

Overall, this symposium provides a data-based analysis of Integrated Learning Systems to inform educational computing's larger responsibility to help schools and school systems make the best decisions regarding investments in instructional technology.

Special Presentation –Panel (T4-05)

Restructuring Education Through Knowledge–Building Communities Supported by Computer Networks

Hope Erickson and Barbara Bowen
Austin, Texas

Abstract

Abstract not available at press time

Projects (T4-06)
Special Needs

A Multimedia Simulation for ESL Students: Interacting in the University

Marianne Phinney
University of Texas at El Paso
El Paso, Texas

Abstract

This presentation will describe the development of an interactive application for high-beginner/low-intermediate proficiency ESOL students using AmigaVision which simulates various interactions students normally have on a university campus. Each module focuses on a topic (paying fees and tuition; student-teacher relationships; boarding a bus), language functions (asking for information, responding to personal questions, making choices), and language structures and vocabulary. Using videotape shot on location and controlled through a NEC PC-VCR, the student will move through the simulation, making choices about the appropriate language to use to achieve an objective. The PC-controlled VCR allows the AmigaVision program to locate and display video sequences and stills. At any point in the sequence, the student can review the language functions of the module, the language structures, or the vocabulary.

The PC-VCR permits use of customized video images so that students can practice in real language in real situations before going "live." The Amiga was chosen as the platform because it allows combination of live video, stills, and computer graphics on the same screen for moderate cost.

The Integration of Interactive Multimedia, Cooperative Learning, and Special Populations

Mark A. Puchalski, Jeanette Cook, and William Simonsen
Glenbrook North High School
Northbrook, Illinois

Abstract

As the educational paradigm of the future evolves from traditional teacher dominated instructional means, the role of technology will certainly shift the model to more student centered instructional methods. Utilizing cooperative learning strategies and an interdisciplinary team taught approach, the Glenbrook Schools have initiated a program to improve its instructional delivery system in Science, Mathematics, Social Science, and Language Arts to learning disabled and other at risk students.

The focus of this project is the integration of interactive multimedia technology into an interdisciplinary curriculum for special populations The media includes computer enhanced instructional techniques, interactive videodisc technology, and satellite television. The project envisions the possibilities for multimedia and videodisc presentation to cross grade levels in order to meet a variety of student needs, abilities, and learning styles. Additional strategies for using interactive multimedia in a variety of formats ranging from whole class presentation through small group activities to individual research will be presented. Besides interdisciplinary and cooperative learning approaches, related themes such as critical and creative thinking, peer coaching, group dynamic skills, global understanding, along with performance based assessment of student progress will be discussed.

"Speak Up", Multimedia and Whole Language with ESP*

Debra Freedman
Brooklyn, New York

Abstract

Listening Speaking, Reading and Writing are the communication skills being developed by the ESP* (Extra Special People) Special Education Speech students at an urban Junior High School in Brooklyn, New York.

These skills are being developed through the use of the microcomputer, telephone, video recorder and VCR. This creates a multimedia learning environment which enables the students to experience a feeling of personal worth, self-esteem and accomplishment. Language is used naturally in everyday living situations. Language is acquired by using it...not by practicing its separate parts. The method, "Whole Language."

The object of this project is to eliminate the fear of communicating on the telephone by developing the essential speaking and listening skills. The students brainstorm ideas, using the computer (word processing). They write their own scripts necessary for role playing telephone conversations. The telephone conversations are videotaped. Peer evaluation is part of the lesson. This method encourages peer interaction, collaborative learning and individualization.

By combining the "Whole Language" philosophy with multimedia, learning and understanding occur spontaneously in enjoyable situations. This is a challenge to the students as well as the professionals in the educational field.

"AT Risk Students" DO Read and Write!

Irene Brock and Glenda Hay
Beaumont, Texas

Abstract

The presenters will demonstrate how to get "At Risk" students to select and read an entire book thoroughly, enjoy the book, and respond to what was read by utilizing four unique graphic tools in conjunction with a word processor to develop thinking skills.

Students show tremendous improvement in reading, thinking, writing, spelling, and grammar skills when allowed to think and then write with computer tools. They have great pride in their work when it is edited and polished so it looks professional when printed. Students learn to enjoy a book, and for the first time, really understand the entire book. No longer can students get by with skimming a book. They must have read and understood the book to be able to complete the projects.

Paper (T4-07)

Beyond Programming: A Two-Summer Computer Science Institute for Secondary Teachers

Brian Harvey
University of California, Berkeley
Berkeley, California

Abstract

1992 marks the fourth summer of the Institute for Secondary Mathematics and Computer Science Education (IFSMACSE), an NSF-sponsored program for high school teachers held at Kent State University. The program is divided into separate strands for mathematics and computer science; this paper describes the computer science strand.

In its first three years, IFSMACSE has served about 240 participants, including 90 in computer science. It has, therefore, had a visible impact in Ohio and the neighboring states, especially since one component of the Institute is an Intervening Year Project in which participants bring the ideas of the Institute back to their colleagues through inservice workshops, local curriculum design, and demonstration teaching. (Participants attend the Institute during two consecutive summers.)

IFSMACSE is both technically and pedagogically innovative. Its curriculum goes far beyond what is usually expected of high school teachers (or their students); in computer science, participants study both functional programming (in Logo) and procedural programming (in Pascal) paradigms, and such advanced computer science topics as automata theory and compiler construction. Our high expectations are made realistic by the heavy use of experiential and cooperative learning techniques. Participants learn by experiment, rather than by listening to lectures. In the mathematics strands as well as in computer science, we emphasize the use of programming languages as open-ended experimental media, rather than more specific "courseware."

In addition to describing ways in which IFSMACSE has been successful, this paper discusses two ongoing problems. One is the difficulty that participants have with the idea of functional objects; another is the tenacity with which many participants' abstract educational theories prevent them from observing their own learning experiences clearly.

Introduction

The Institute for Secondary Mathematics and Computer Science Education (IFSMACSE) is a summer program for high school teachers that has been funded by the National Science Foundation for three groups of participants over four summers. (Each participant attends the program during two consecutive summers.) It is held at Kent State University, in Kent, Ohio. Participants have been chosen mainly from Ohio and its neighboring states, although a few have come from as far away as Alaska and Pago Pago. The Institute's ambitious and innovative program has attracted a well-known, international faculty that includes high school teachers as well as university professors.

IFSMACSE Directors Ed Dubinsky (Purdue University) and Olaf Stackelberg (Kent State University) began planning for the Institute in 1986 and organized a planning conference in July, 1987. The first group of participants began attending the Institute in the summer of 1989. Here is how one funding proposal described the needs that IFSMACSE was designed to meet:

New sophistication in the curriculum

The traditional subject matter of secondary mathematics has followed a narrow path leading to the calculus. Not only has computer science raised new interest in some classical mathematical topics not currently in the curriculum, but other areas within mathematics (discrete mathematics, abstract algebra, statiscs, fractal geometry) have risen from obscurity to new importance. Secondary teachers are often untrained in these areas.

New methods of teaching

Organizations such as the National Council of Teachers of Mathematics (NCTM) and the Mathematical Association of America (MAA) have concluded that the traditional approach to pedagogy in mathematics has had too much emphasis on memorization of facts and algorithms, and not enough of the flavor of how mathematics is done and how it is used. IFSMACSE emphasizes learner-centered activities rather than lectures as the primary style of pedagogy.

New uses of technology

Computers and graphing calculators are becoming widely available in schools. Teachers require training in these technologies, including general-purpose software such as spreadsheets, software packages designed specifically for education, and new programming languages designed for use in mathematics education.

Each participant attends IFSMACSE for two consecutive summer sessions, each of which is six weeks long. The academic day includes four 90-minute periods. Typically, a participant spends two of those periods in formal class meetings, while the other two periods are available for work in the computer labs. (We use several labs, some containing networked Apple Macintosh computers and the others using networked IBM PS/2 computers.) Evenings are for reading, recreation, additional lab time, and scheduled guest speakers and similar events.

The division of the day between formal class meetings and open lab times may be misleading, because even during formal classes we try to devote as much time as possible to collaborative lab work rather than to lectures or demonstrations. The difference is that during the formal class sessions all members of a class are present at the same time, along with a faculty member. (This ideal of lab-based classwork is not perfectly met. A few of the IFSMACSE classes have relied more heavily on lectures than we'd like, and even in the most experiential class there is an occasional summary lecture. But we try to introduce new concepts through "guided discovery" exercises, saving the lectures for after the exploration.)

The participants are divided into mathematics and computer science strands. In the first two IFSMACSE classes, there were two mathematics strands, one focusing on new topics in mathematics, and the other on the use of computer technology in learning mathematics. These were merged for the third class, starting in 1991, by combining courses from the two curricula. The IFSMACSE computer science curriculum has maintained the same general structure for all classes, although of course some of the details have changed.

I was part of the design group for the computer science strand at the 1987 planning meeting, and have taught about half of the courses in that strand at the Institute. In 1990 I was appointed an associate director of IFSMACSE.

The Computer Science Strand

Two overall points of view can be distinguished in computer science education [Harvey, 1991]. The mainstream *software engineering* approach is exemplified by the Computer Science Advanced Placement exam, which emphasizes sequential, procedural programming methodology and top-down design. Courses following this approach are typically taught using Pascal or Modula-2. An alternative view, using sy*mbolic programming* ideas, was pioneered at the Massachusetts Institute of Technology [Abelson and Sussman, 1985] and emphasizes functional programming style and interactive development. Courses using the second approach are often taught in Scheme or some other dialect of Lisp.

In designing the IFSMACSE computer science curriculum, the participants at the planning meeting wanted to ensure that both approaches would be represented. (Our own personal leanings were mixed.) As a result, Institute participants take two introductory programming courses, one each summer; the first is Logo-based and the second uses Pascal. We chose Logo rather than Scheme to represent the symbolic programming approach partly because the Abelson and Sussman text is more advanced than what we wanted for an introductory high school course; partly because Logo is more generally known in schools; and partly because we had an appropriate Logo-based text available [Harvey, 1985].

Each programming course extends beyond the usual high school level of sophistication, although we think that they are not beyond the abilities of high school students. The Logo course includes very little of the traditional turtle graphics activities, focusing instead on functional programming and list processing. Advanced ideas such as recursion and higher-order functions (that is, functions that operate on other functions as data) are challenging to the participants, but once learned, they allow complicated problems to be solved elegantly and with minimal effort. For example, consider this short program in the Berkeley Logo dialect:

```
   TO CHOOSE :MENU [:SOFAR []]
   IF EMPTYP :MENU [PRINT :SOFAR STOP]
   FOREACH FIRST :MENU
    [(CHOOSE BUTFIRST :MENU SENTENCE :SOFAR
?)]
   END
```

This procedure contains only two instruction lines, but it uses both recursion (the procedure CHOOSE is invoked within itself) and the higher-order tool FOREACH (applying an instruction to each element of a list) to solve a tree-structured problem. When invoked with a "menu" of independent choices, it prints every possible combination of choices, like this:

```
? CHOOSE [[SMALL MEDIUM LARGE]
            [VANILLA [RUM RAISIN]
             GINGER RASPBERRY]
            [CONE CUP]]
SMALL VANILLA CONE
SMALL VANILLA CUP
SMALL RUM RAISIN CONE
SMALL RUM RAISIN CUP
SMALL GINGER CONE
SMALL GINGER CUP
SMALL RASPBERRY CONE
SMALL RASPBERRY CUP
MEDIUM VANILLA CONE
MEDIUM VANILLA CUP
MEDIUM RUM RAISIN CONE
MEDIUM RUM RAISIN CUP
MEDIUM GINGER CONE
MEDIUM GINGER CUP
MEDIUM RASPBERRY CONE
MEDIUM RASPBERRY CUP
LARGE VANILLA CONE
LARGE VANILLA CUP
LARGE RUM RAISIN CONE
LARGE RUM RAISIN CUP
LARGE GINGER CONE
LARGE GINGER CUP
LARGE RASPBERRY CONE
LARGE RASPBERRY CUP
```

(In dialects of Logo other than Berkeley Logo and Object Logo, the FOREACH tool is not automatically provided, but it can be written in Logo.)

The Pascal-based course in the second summer is divided into two three-week components. The first is an introduction to the Pascal language comparable in scope to the Advanced Placement course. The second is a course on algorithms and data structures, roughly like the typical "CS 2" undergraduate course. (For example, last summer's offering used the convex hull problem as its first laboratory assignment. This is the problem of finding which points, out of an arbitrary set of points chosen in the plane, would be touched by a rubber band that was stretched around the entire set and then allowed to contract.) It may seem remarkable to cover the A.P. syllabus in three weeks, but the participants are working full-time on computer science, and they have already had an advanced Logo programming course the previous year. The algorithms course is taught by Selim Akl, a professor at Queen's University in Ontario and the author of three texts in the area of algorithms [Akl, 1985; Akl, 1989; Akl, 1992]. The introduction to Pascal has been taught by Michael Levy, professor at the University of Victoria, and by Darrell Turnidge, an Assistant Dean of Arts and Sciences at Kent State University and an associate director of IFSMACSE.

Each summer's programming course runs in parallel with a second course in which programming is not the focus, although programming may be used as a learning tool. The first summer's course is about the use of computing in schools outside of computer science proper. This course is offered because a high school's computer science teacher is likely also to be the computing expert who is consulted about every aspect of educational computing. This is the course in the IFSMACSE computer science strand that has changed most over the three summers in response to pragmatic needs. As originally designed, the course had two three-week sections. The first was about the technical "nuts and bolts" of using computers: word processing, spreadsheets, and so on, as well as hints about choosing hardware, networking, and similar issues. The second three weeks was an overview of the use of computing throughout the curriculum, combining general readings with a sampler of activities from various disciplines.

This original design has changed for two reasons. The first was that the "nuts and bolts" work turned out to be so popular that participants in the mathematics strands wanted to take the course also. It is taught by Bill Hunt, a Macintosh virtuoso, who is Director of Technology for the Mayfield, Ohio City Schools and a winner of the Presidential Award for Excellence in the Teaching of Mathematics. To make Bill's workshop available to all participants, starting in the second summer it was moved into the evening program.

The second half of the original design was expanded to fill part of the hole thus left in the computer science schedule. The course is taught by Paul Goldenberg, who has taught at all levels from second grade through graduate school and is now a Senior Scientist at Education Development Center in Massachusetts. Paul has enriched the course in two ways. First, he is himself a developer of computer-based curriculum in several areas, including special education [Goldenberg, 1979; Goldenberg, et. al., 1984], linguistics [Goldenberg and Feurzeig, 1987], and fractal geometry [Goldenberg, 1989]. Second, as an experienced process group leader with psychodynamic training, Paul has introduced a group discussion component to the course. He divides the participants into two groups of 15; while one group is working independently in the computer lab, the other is meeting with Paul for a wide-ranging discussion of participants' concerns about educational issues. These discussions have no predetermined agenda, and their character has been very different from one group to another, but they are always strongly connected with other parts of the IFSMACSE program and help participants understand more fully the pedagogic implications of their experiences as learners for their later work as teachers.

The non-programming course in the second summer is a sampler of topics in computer science, including automata theory, discrete mathematics, programming languages, and artificial intelligence [Harvey, 1987]. The rationale for this course is that many students leave high school thinking that a computer scientist is someone who knows two dozen programming languages, and with no idea about the range of topics they'll meet in college. As in IFSMACSE's mathematics courses, the goal is to use the computer as a medium that allows an experimental approach to otherwise abstract ideas. For example, participants explore automata theory using two computer programs, one of which simulates a finite state machine, while the other translates a regular expression into a finite state machine. Before there is any introduction of technical vocabulary, participants use the FSM simulator to play a sort of "guess my rule" game in which the rules specify allowable strings of letters using only the letters A, B, and C. (One possible rule is that the string must start with A and end with C.) FSM notation is introduced as a way to express the game rules in an algorithmic form—one that a computer can use directly to check whether a given string follows a given rule.

Success with Experiential Learning

The Advanced Topics course includes two aspects of programming languages. There is a section about language design, in which technical issues such as scope of variables and call by reference are considered in the context of a comparison between Logo and Pascal. A second section, on compiler construction, is illustrated with a recursive descent compiler for Pascal written in Logo. (The object language, into which a Pascal program is translated, is also Logo. This makes the compiler somewhat unrealistic but also keeps it portable and makes it possible to discuss front-end parsing issues without having to learn about native machine languages.)

I have taught this course twice at IFSMACSE. The first time, I hadn't managed to invent experiments for the participants to use in exploring the ideas. In fact, I didn't think any such activities were possible for the first part, on language design. I did have ideas for activities in the second part, but those ideas were mostly extensions to the already-written Pascal compiler, and required that the participants already understand the structure of the program. Therefore, I ended up doing a lot of lecturing during those weeks. The participants, who had felt quite comfortable with automata theory and discrete mathematics because of the activity-based approach, ended up feeling that the topic of programming languages was too hard for them.

The second summer, before any discussion of programming language design, I gave the participants the following assignment: "Write programs for each of the following in as many languages as possible. Feel free to consult with other people who know these languages better than you do. You should at least be able to do Logo and Pascal; other possibilities are Scheme, ISETL, and BASIC. Some programs may turn out to be impossible in some languages."

1. Mergesort an array or a list of numbers.
2. Shuffle an array or a list of numbers.
3. Exchange the values of two variables.
4. Take a function F as input; output the function that computes $F(F(x))$ for input x.
5. Compute all the prime numbers less than an input N. (Output an array or a list.)
6. Compute all the factors of an input N.

Participants were already familiar with Logo (a list-based language) and Pascal (an array-based language). ISETL is a functional language with a notation designed to be very close to standard mathematical notation, in which the main data aggregate is the *set*, essentially an unordered list. ISETL is not taught in the computer science strand, but is heavily used in the mathematics strand, so the CS participants were encouraged to consult their friends in the other group. Scheme had not previously been used by either strand, but it was installed on the computer network for this week and I used two class sessions to demonstrate it and encourage the participants to play with it.

Participants varied widely in the degree to which they completed the assignment, which called for six programs in each of five languages. But one of the great virtues of the experimental approach is that it isn't necessary for a learner to complete assignments! Any participant who made any serious effort at all quickly saw that only languages with first-class functions, such as Scheme and ISETL, allow the fourth problem to be solved. Most participants—even if their programs never worked—saw that lists are easier to mergesort than arrays, but arrays are easier to shuffle. Filtering problems such as the last two are naturally expressed "all at once" in languages with higher-order functions, but are expressed as iterative loops in languages that emphasize iteration.

A similar activity-first approach also rescued the compiler unit. I had originally chosen to work with a Pascal compiler in order to demonstrate the nature of lexical scope. But the very complexity of this issue, and the corresponding recursive structure of the compiler, made this a bad starting point for an activity approach; the participants would never have written a Pascal compiler from a blank start. Instead, we began the week by taking on the easier task of a BASIC compiler. BASIC is structurally simple because each instruction line begins (not counting the line number) with a keyword (such as LET or PRINT) that specifies the kind of instruction on the line. The computer lab was arranged as five large clusters of tables, each with about six participants. I assigned each group a statement type, and told them to write a procedure that would take a BASIC instruction line as its input, and would define a Logo procedure to carry out the instruction. We deferred until later the top-level structure that would invoke their procedures and assemble the completed program. (As it turned out, I decided to write this part myself because it involved a few annoying technical issues and no real intellectual ones.)

In a week of work, we never did put together a complete compiler. But the participants all had to work out several issues in their understanding of how to write one. The biggest issue was their tendency to confuse the variables that are part of the compiler itself with variables that belong to the compiled program. This confusion worked both ways; they would try to examine during the compilation process variables that wouldn't exist until the program was run, but they also put into the compiled code references to variables within the compiler. Every group did advance their work to the point at which this confusion was clarified. The issue is a profound one. A compiler breaks down the simplistic wall between program and data in the minds of beginning programmers.

Another issue that came up in the participants' work was tokenization. The tokenization rules for Logo are very similar to those of BASIC; for example, the arithmetic operators are tokens in themselves. But there are a few differences. The most important turned out to be that the comma is a delimiter in BASIC but not in Logo. The groups working on the INPUT and PRINT statements quickly got bogged down in trying to extract commas from words. I suggested that these groups split their efforts; one subgroup would compile the statements assuming that any comma would be seen as a separate word just as a plus sign would be, while the other subgroup worked only on this tokenization task. Later, in a discussion with the entire class, we all agreed that it would be more sensible to design the compiler in a way that made tokenization an entirely separate task, done uniformly for all statement types, rather than as a subtask of compiling each statement type.

Although we never did examine the Pascal compiler from the textbook in any detail, the participants' experience struggling with compile-time versus run-time variables was enough preparation so that I could tell them about the implications of lexical scoping rules even though they didn't work out the actual process of implementing those rules. Had we had more time, I would have tried to introduce scoping, too, through activities. But the lecture that I gave as a shortcut was vastly more successful than a similar lecture the previous summer to participants who hadn't had the activity of struggling to write a BASIC compiler.

The Difficulty of Understanding Function as Object

The idea of *function* is central to mathematics, and central to the mathematics curriculum at IFSMACSE. Less obviously, it has turned out also to be central to the computer science curriculum.

Students notoriously have trouble understanding functions. For example, this trouble is at the root of their difficulty in freshman calculus. Mathematics educators have focused much research on illuminating functions. It appears that mathematicians understand functions in at least two ways, one of which is much harder than the other [Dubinsky, 1991].

The easier level of understanding is that of *function as process*. This is the view exemplified by the "function machine" of high school algebra, the meat grinder that accepts numbers through a funnel at the top and cranks out other numbers through a chute at the bottom. *Composition of functions* can be understood as hooking the output chute of one machine to the input funnel of another. In this view, the "real things" that we manipulate are the numbers; functions are ways in which we manipulate those things. This view of functions is straightforwardly modeled through procedures in a programming language. (In fact, many languages use the word "function" to name such procedures.) Consider the common metaphor in which a procedure is described as a recipe; it is perfectly clear that the "real things" that we eat are the ingredients, not the recipe itself. You can't eat a recipe, nor can you eat the sequence of steps (turning on the stove, and so on) that the recipe tells us to perform.

The second level requires us to understand *function as object*. In this view, functions are promoted to "real things" that can themselves be manipulated. In calculus, *derivative* is a function whose domain and range are functions. If we represent this function as D, we may loosely write that $D(x^2)=2x$ but this notation is misleading because x^2 and $2x$ are expressions that represent numbers. We really mean something like

$$D(f : x \text{ ' } x^2) = (g : y \text{ ' } 2y)$$

(I have given the function g a different formal parameter to emphasize that this formula is about f and g, not about x or y.) If we want to represent the function D as a machine, it can't be a meat grinder, but rather a "metal grinder" that takes meat grinders—not the values output by meat grinders, but the machines themselves—in its input funnel. Although we are still understanding the *higher-order* function D as a process, we must now understand the functions f and g as objects.

In Logo programming the difficulty about function as object first arises in using the IF procedure for conditional execution. In the instruction

```
IF EQUALP :VALUE 3 [PRINT  THREE]
```

why are there brackets around the PRINT instruction but not around the EQUALP expression? We tell Logo beginners that things within brackets are literal text, while things not in brackets are requests to carry out procedures:

```
? PRINT [SUM 2 3]
SUM 2 3
? PRINT SUM 2 3
5
```

When they meet IF, these beginners want to say

```
IF EQUALP :VALUE 3 PRINT  THREE
or
IF [EQUALP  :VALUE  3] [PRINT  THREE]
```

Although this presents itself as a syntactic question, about brackets, it's really a problem about functions as objects. IF is a higher-order procedure. Its first input is *not* a function, but rather a TRUE or FALSE value. But its second input *is* a function, in the form of a Logo instruction. The first incorrect form above would invoke PRINT, actually printing the word THREE, before invoking IF. The second incorrect form would put the expression EQUALP :VALUE 3 in IF's first input funnel, instead of supplying IF with the true or false value that results from invoking EQUALP. Saying the same thing in different words, we are using EQUALP as a function-as-process, but we are using PRINT as a function-as-object.

This difficulty arises in Logo programming because Logo treats IF as a procedure that is syntactically like any other. It requires two inputs, a true-false value and a function. But the idea of a functional object is so hard for many people to learn that some dialects of Logo avoid the issue by making IF a special syntactic construction, unlike everything else in the language, looking more like the IF statements of other languages:

```
IF EQUALP :VALUE 3 THEN PRINT  THREE
```

This gets past the immediate hurdle, but it misses the chance to teach a valuable lesson. Functional objects, once understood, add great expressive power to a language. For example, we can write in Logo a higher-order function called MAP that applies any function to each of the elements of a list:

```
? SHOW MAP  SQUARE [4 5 6 10]
[16 25 36 100]
```

(The FOREACH procedure used in an earlier example is a similar higher-order tool.) MAP performs "all at once" computations that would otherwise require some sort of looping mechanism with auxiliary variables. But why is the function name SQUARE quoted? Ordinarily we quote data words, not procedures. This is exactly the same issue that IF raised; the first input to MAP is the SQUARE function itself, not the result of squaring something. The particular details of punctuation are specific to Logo, but any language that allows higher-order functions needs some notation to distinguish the invocation of a procedure (the use of a function as process) from the procedure itself (function as object).

The same broad issue comes up differently in studying compilers. Here the problem has nothing to do with syntax. It presents itself very directly: We are working with some procedures, the ones in the compiler itself, that we think of purely as process. Other procedures, the ones in the program that is being compiled, must be considered as objects during the compilation process, but then mysteriously represent a process when the compiled program is executed.

Higher-order functions are tools whose usefulness is too great to pass up, and yet our experience with the IFSMACSE participants shows that the underlying ideas are surprisingly difficult to learn. We know some ways to begin; for example, turtle graphics projects can make the issue more concrete [Zazkis and Leron, 1990]. This is an ongoing area of research among the IFSMACSE faculty.

Educational Mythology versus Experience

The final topic in the Advanced Topics course is artificial intelligence. I gave the participants a program called Student to investigate. This program, my translation into Logo of Daniel Bobrow's original 1964 Lisp version, solves algebra word problems by using pattern matching to turn the English sentences into equations. The program, typical of AI projects back then, solves an impressive variety of problems but also fails on an even wider variety. It "understands" certain sentence structures but not others. I had asked the participants to try out problems of their own. If the program failed to solve a problem, I asked them to try to figure out how the program would have to be modified to succeed. In retrospect, this was too hard an assignment, because Student has a very complicated structure and a week was too short a time to allow its exploration.

On the next-to-last day of the Institute, a few of the participants were working on Student, others were doing their Pascal homework, and others were having conversations. At one point a few of the side conversations got quite boisterous, creating an atmosphere in which it was hard for anyone to work. I got angry and let the participants know it, inviting those who weren't working to leave but insisting that they not prevent others from working.

The next day, i.e., the last day of the Institute, Paul Goldenberg invited me to visit his class session with the first-year participants. They had had a discussion about grades, and he was about to hand out a position paper he'd written overnight on the subject. (Of course we don't give grades at IFSMACSE, and the participants all agree that it would ruin the experience for them if we did, but many feel that high school students are different from themselves and need grades.) Paul's paper suggested some ways in which grades can be given to reduce their harmfulness and, in some cases, even allow grades to contribute to the learning process. He thought that I would consider this "a sellout" (his words) and wanted me to present my own views. What I said, in brief, was that dealing with grades is just like any other tension between reform and revolution, and that I think reforms are fine, and even necessary, as long as we design our reforms while keeping in mind the revolution that we really want. (I don't expect that sentence to be convincing; the argument about reform and revolution isn't the point I want to make here, but rather part of the background.)

At this point one of the participants said to me, "Don't you think that if you gave grades you wouldn't have had that trouble with the second-year participants yesterday?"

After getting over my (naive) surprise that this story had reached the IFSMACSE gossip mill, I gave two replies. The first was that even if I could have "maintained discipline" by force, which is what she was suggesting, the cost would be too great. I wouldn't trade six weeks of fearless exploration of difficult ideas for one day of decorum. My second reply was a question: "Have you ever taught seniors?"

> "Yes."
>
> "Do you give them grades?"
>
> "Yes."
>
> "Do the grades prevent them from having senioritis
> on the next-to-last day?"
>
> "Are you kidding? They get senioritis in November!"

This participant knows that you can't maintain order in a classroom by using grades as a weapon, from her own teaching experience. She *knows* that she herself, at IFSMACSE, works hard and learns rapidly and deeply in an atmosphere without grades, and that if we gave grades she would be more afraid to challenge herself. But she also "knows" that students won't learn anything if you don't force them to. That last bit of knowledge does *not* come from her experience; she learned it from gossip in the staff room, or during her training, or from the newspaper.

In designing IFSMACSE we knew from the beginning that the technical content and the pedagogic content were equally important. Just as we teach the technical ideas not by lecturing, but by participant exploration, we also feel that we can teach our pedagogic ideas best by example. Still, we find that it's important to make explicit, repeatedly, that we are modeling an approach to teaching and learning that will work for the participants and their own students. Many of them find our methods congenial, but many are very reluctant to apply their own observation of their own learning to the situation at home. This fear—a strong word, but appropriate—is another of the difficulties with which we are still struggling at IFSMACSE.

Acknowledgments

The IFSMACSE faculty are all profound thinkers about both education and mathematics, and my work with them has been a terrific intellectual stimulation. The people whose insights are most visible in this paper are Al Cuoco, Ed Dubinsky, Paul Goldenberg, and Uri Leron.

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Paper (T4-07)
Revitalizing High School Computer Science

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Abstract

This paper is our first report about using a school-industry-university coalition to revitalize computer science education in public high schools. We describe our pilot project, the installation of an entirely new computer science curriculum in one Massachusetts town. We introduce the members of the coalition that made the pilot project possible, state our goals, describe our progress toward those goals, and discuss our plans for disseminating the pilot project to other towns.

Introduction

The pilot project and the members of the coalition

Our pilot project is underway in the town of Westford, MA. As in many towns in economically depressed Massachusetts and elsewhere, many Westford residents and teachers have the will to improve public education, but not the way. The town has repeatedly voted down tax-cap overrides. The problems of dwindling computer science enrollments and an outdated computer science curriculum are being addressed by a coalition of people from industry, from a local university, and from the school.

Industry is represented in the coalition by the Westford Partnership for Excellence in Public Education, Inc. Founded by a group of visionary residents, the Partnership is doing a great deal to make up for missing tax revenues. It is much more than a community chest. It is an active team of residents and industry representatives with dual goals. One goal is to funnel the resources of the community (not just money, but also equipment, materials, and the time and expertise of townspeople) to the schools. The other more difficult and less quantifiable goal is to foster in Westford an atmosphere in which learning can flourish.

The higher education member of the coalition is the University of Massachusetts Lowell (formerly the University of Lowell), which is part of the state university system. Three centers within the University have been instrumental in bringing the Westford project to fruition: the Computer Science department, the Center for Productivity Enhancement, and the Center for Field Studies. The number of computer science majors at UMass Lowell has been declining, in keeping with national trends. The Westford project is an opportunity for the University both to transfer technology to the community and to recruit future students for college computer science programs.

The two computer science teachers at the town's public high school, known as Westford Academy, are naturally also members of the coalition. They became alarmed about their declining enrollments and outdated curriculum, which until this year consisted of a three-year sequence of programming courses in Basic and Pascal. Students implemented their programs on a PDP/11 with VT100 terminals. The teachers joined forces with UMass Lowell, and the Westford Partnership to increase enrollments and update the curriculum. Section 2 describes the goals of the pilot project. Section 3 details our progress toward achieving those goals and presents data collected so far. Section 4 outlines our plans for disseminating the project to other communities, and Section 5 describes our plans for future assessment.

Goals for the pilot project

The school, Partnership, and University have several goals in common for the project:

- Increase computer science enrollment, both at Westford high school and at UMass Lowell.
- Get students interested in how computers work by having them experience what computers can do.
- Install up-to-date equipment in Westford's computer lab.
- Transfer technology from the University to the teachers and student aides.
- Contribute to making Westford a community where learning can flourish.
- Increase students' sensitivity to the effects of computerization on society.

Progress toward meeting the goals

In this section, we describe our progress toward our goals. Much of the data comes from a questionnaire that was administered to the 47 students present at the first class meeting of the three sections of the new course. The questionnaire had 51 items, of which two were concerned with demographic data, 22 with previous experience with computers, 13 with areas of interest, and 14 with attitudes toward computers. The six students who joined the course subsequent to the first meeting were not surveyed. It would have been unfair to require them to miss class to fill it out, yet had they filled it out later, their responses would have been influenced by attending class.

Increasing enrollment. Coincidental with the advent of the new computer science curriculum, enrollment has increased significantly. The number of students enrolled in computer science courses increased from 21 in 1990-91 to 53 this year, an increase of 152%. At the same time, the total enrollment of the school decreased from 874 in 1990-91 to 834 this year, a decrease of nearly 5%. Thus, enrollment in computer science courses has gone from 2% of the student body to 6%.

A subgoal of increasing enrollment was to recruit more girls into the class. There were four girls enrolled during the 1990-91 school year; this year there are 11, not a significant increase percentage-wise. We hope that the new laboratory-based curriculum will give girls the kind of experience they need to be comfortable with and successful in computer science [Bernstein 1991], and that they will recommend the course to their female friends.

Figure 1 is a double-Y-axis graph that shows how the number of students taking computer science courses has changed over the past nine years, from a high of 252 students in 1983-84 to last year's low of 21. It also shows the history of total enrollment over the same period, from a high of 946 in 1984-85 to a low of 834 this year. The increase in computer science enrollment this year is dramatic in the light of the decrease in total enrollment.

In the opinion of teachers and guidance counselors, the sharp decline in computer science enrollment between 1983-84 and 1990-91 is attributable to two factors: (1) students were not interested in programming as an end in itself, especially on text-oriented monitors; and (2) the business department started offering applications courses (e.g., word processing) using modern equipment such as Macintosh computers.

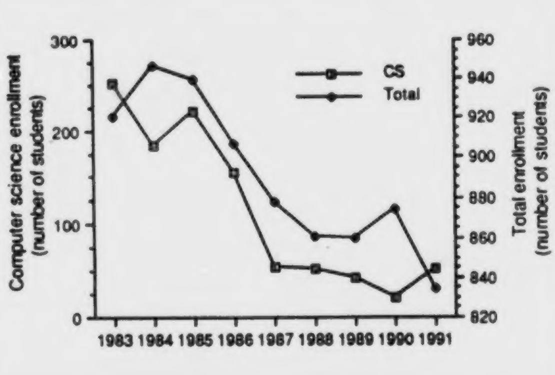

Figure 1. Computer science enrollment and total enrollment for the academic years beginning in 1983 through 1991. Notice this year's rise in CS enrollment despite the decline in total enrollment.

In the opening-day questionnaire, we surveyed students about their previous computer experience. All but four of the 47 students surveyed have at least one computer at home; 17 have more than one. Figure 2 shows the types of uses students have made of computers in the past. Many of these students have seen or used computing environments (both hardware and software) far more modern than what the old lab offered. They may have felt that they were taking a step back in history when they walked into the classroom. We find that many of these students are already more experienced with computers than the incoming college freshmen surveyed by Harrington [Harrington 1988].

We surveyed students about their reasons for electing to take the new computer science course. Of the 47 students who filled out the questionnaire, one student gave no reason; 30 students gave one reason; and 16 students gave two reasons, both of which were tabulated. Answers fell into six categories: (1) interest in the specific new topics included in the course, in particular animation and robotics; (2) interest in Pascal programming and data structures; (3) general interest in computers and programming; (4) the importance of computer knowledge for college and career, including finding out whether computer science would be an appropriate major; (5) recommendation of a teacher, guidance counselor, or fellow student; and (6) interest in using the new computer equipment.

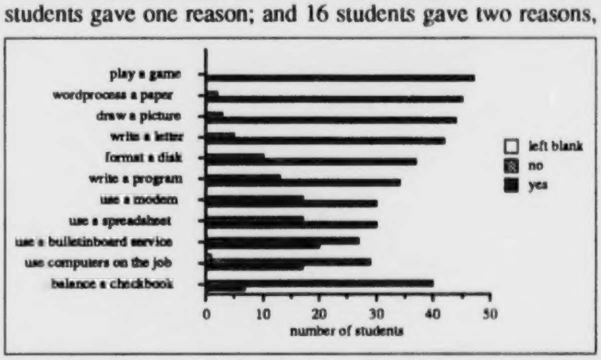

Figure 2. Previous computer use. Students were surveyed about their experience using computers. Responses are arranged in descending order of "yes" answers, from top to bottom.

Figure 3 shows the number of students whose answers fell into each category. 5 students (11 %) said that they enrolled because they were interested in Pascal programming and data structures. These students would most likely have signed up for the old curriculum, which consisted exclusively of programming and data structures.

In contrast, the first category (interest in specific new topics) and the last (interest in new equipment) account for a total of 16 students (35%). Their reasons for taking the course suggest that they would not have been as motivated to enroll

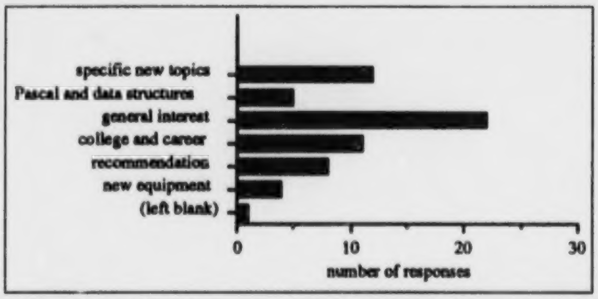

Figure 3. Profile of students' reasons for enrolling. Students who said that they were interested in specific topics in the new curriculum, that they wanted to use the new equipment, or that someone recommended that they take the course are presumed to have been attracted by the new computer science program.

under the old curriculum. Additionally, recommendation of a teacher, counselor, or fellow student was mentioned by 8 students (17%), including students who learned about the new curriculum by word-of-mouth PR. Advance publicity made it clear that there was more to learn in the new course than programming. We surmise that at least some students in this group were motivated to enroll by the promise of a new curriculum. The remaining categories (the importance of computers for college or career and general interest in computers and programming) account for a total of 33 responses, given by 28 students (61%), half of whom gave more than one response. We speculate that this group may include some students who would have enrolled in a computer applications course in the business department if the new computer science curriculum were not offered. We have requested information about business department enrollments to see if they were affected by the new computer science curriculum.

We conclude that the introduction of the new curriculum led to an initial increase in enrollment in this year's computer science classes. However, important questions remain: will students finish out the year and will they recommend the course to other students?

We are also interested in increasing computer science enrollment at the college level. In the opening-day questionnaire, we asked students to tell us whether they had chosen a college major, and if so what the major was. 11 students (23%) said computer science or computer engineering. 19 (40%) said that they were undecided or left the item blank. The other 17 gave 17 different majors ranging from the architecture to zoology. We will administer an end-of-the-year questionnaire, to see whether the course influences students toward (or away from) majors in computer science. While there is no particular reason to expect that Westford students will attend UMass Lowell, the propagation of this project to additional schools is bound to impact college enrollments in general.

In addition to increasing numbers of students who go on to take computer science in college, we hope to increase their success rate. The contribution of high school computer science to success in college-level CS courses has been demonstrated by Taylor and Mounfield [Taylor and Mounfield 1989].

Get students interested in how computers work by having them experience what computers can do. This is how we state our main curriculum goal. Our approach to achieving it is to give students the tools, especially fourth generation languages (4GLs), to create sophisticated applications quickly while learning the concepts of computer science — to hook them, so that they will want to understand the way things work. Curriculum development has been influenced by the authors' work in the area of visual languages [Canning, 1991; Canning et al., 1991; Williams et al., 1989]. Pascal programming and data structures remain a vital part of the curriculum, but programming is presented as a necessary tool, not as the ultimate goal. See Table 1 for an overview of the laboratory-based curriculum.

During the first year, students will program computers to: 1) create electronic presentations via visual authoring systems; 2) create graphics and animation sequences merged with sound and video; 3) create and maintain databases of text, graphics, and digital images; 4) control the action of robots and manipulate a small robot based factory; 5) create and edit video tapes; and 6) write and execute Pascal programs.

	Year I	Year II	Year III
Semester 1	Visual Authoring Animation A Pascal Programming A	Multimedia/Video B Vision/Robotics B Animation B Pascal Programming C	Computer Architecture Telecomm/Networks Pascal Programming E
Semester 2	Robotics A Multimedia/Video A Database A Pascal Programming B	Database B Image Processing Pascal Programming D	History of Computing Pascal Programming F Data Structures

Table 1. Projected 3-year laboratory-based curriculum. Year 1 is currently under way.

For each curriculum module, students will produce an end product. For example in the visual authoring module, Asymetrix's ToolBook Version 1.5 is used to create hypermedia presentations. Students learn how to storyboard and implement a presentation by merging text, graphics, and images. A small amount of work yields immediate visual feedback, in stark contrast to the tedium of traditional programming. ToolBook is similar to HyperCard, which has been used in undergraduate computer science survey courses both for majors [Katz and Porter 1991] and non-majors [Decker and Hirshfield 1990].

ToolBook also provides the ability to write simple page-flipping animation sequences. Additionally, the Animation I module will rely on two other software packages which run on Commodore Amiga technology (made available by the University). Students will create smoother, more realistic animation sequences using Disney's The Animation Studio and Byte by Byte's Sculpt Animate 4D. Sculpt Animate 4D software allows students to position virtual light sources within the animation so that reflection and shadowing exist in the final product.

The multimedia module will explain the basic concepts and technology of multimedia. This module builds upon the animation and authoring units since multimedia comprises elements of animation, graphics, text, and sound, together with video. Students will produce their own videos using special effects video equipment, such as NewTek's TOASTER software/hardware running on the Amiga and IBM's Audio Visual Connection (AVC) system.

During the Robotics unit students will have hands-on experience with two robotic systems. Initially students will interface Teach Mover robots manufactured by UMI-Microbot, Inc. with a Pascal program. The Pascal program plays a game, such as checkers, and sends signals to the robot to physically move the pieces. Students will gain access to a second robotic system, the Lincoln Log Factory of the Future, physically located at UMass Lowell, via two-way interactive television. Using this technology, students, from their high school classroom, will interactively control the factory to build a log cabin of their design.

We surveyed students to learn their level of interest in the various topics of the first year's curriculum. Students were asked to indicate their level of interest in a given topic on a nine-point scale, from "definitely not interested" to "definitely interested," with the additional choice of "don't know." Figure 4 shows a profile of student responses. Students showed the greatest interest in animation and robotics (in each case, 25 students [53%] said that they were definitely interested). Students were least interested in the history of computing (only 5 students indicated strong interest; 25 [53%] indicated strong lack of interest). Many students said they "don't know" about databases, data structures, telecommunications, and visual authoring. We intend to re-ask this set of questions at the end of the school year. We hypothesize that the number of "don't know" answers will diminish. We also hypothesize that there will be shifts in students' level of interest in various topics based on their experiences in the course.

Install an up-to-date lab. The computer science courses historically used a PDP-11 that was also used for administrative purposes (record-keeping, scheduling, etc.). The PDP and VT100 terminals were adequate for text-based programming. However, they could not support many of the topics in the new curriculum (including graphics, animation, and visual authoring) nor did they support a sophisticated programming environment, such as Borland's Turbo Pascal. In contrast, the business department had access to a lab of Macintosh computers which support all of the above.

Through the generosity of IBM, a corporate member of the Westford Partnership, the PDP has been replaced by 13 networked PS/2 model 55sx computers (each with 80 megabyte hard drives, six megabytes of RAM, and floppy disk drives) and one PS/2 model 80 (with 16 megabytes of RAM and a 320 megabyte hard drive) which acts as the server for the token ring network. The Partnership is committed to donating additional equipment (fax, postscript printer, Teach Vision systems, etc.) and start-up funds ($19,000) over a three-year period. In addition, another major vendor is preparing a donation of hardware and software that will turn the facility into an open systems lab.

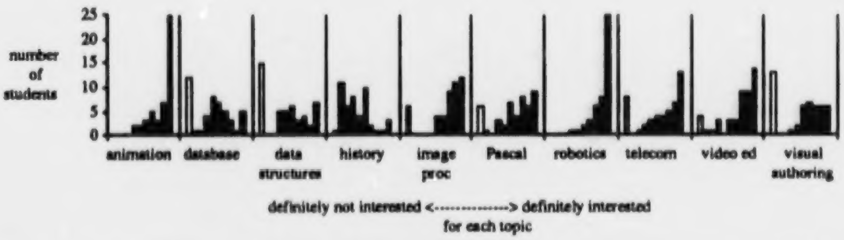

Figure 4. Profile of students' interests. Students were asked to indicate the degree to which they were interested in 10 topics from the new curriculum, on a scale from "definitely not interested" to "definitely interested". The tallies are shown by the black columns. The white columns tally the "don't know" responses.

Transfer technology to the teachers and student aides. Westford's computer science teachers are knowledgeable about Basic programming, Pascal programming, assembly language programming, and data structures. For the current curriculum, they needed to know about networked PCs and about the new topics in the curriculum (visual authoring, animation, robotics, etc.). Additionally, they had to identify and adopt new teaching methodologies appropriate for a laboratory course. They spent a large part of the summer at the University, on a voluntary basis, getting up to speed.

The hardware for the Westford lab was delivered to UMass Lowell at the beginning of the summer. The lab was temporarily installed at the University (a process called "staging") to make sure all 14 machines and the token ring network were functioning together properly. The teachers and student aides participated in staging the lab, under the guidance of University personnel. Just before school opened in the fall, the lab was moved to Westford Academy, where, thanks to what they learned during staging, the teachers were able to install the machines and network themselves.

Because of the teachers' background, we did not need to embark on the kind of formal training program recommended for teachers who are beginning the retraining process [Poirot et al. 1988; Kiper et al. 1989]. We speak of "technology transfer," rather than retraining. The teachers spent the summer learning about the new curriculum areas in a self-paced, hands-on way, with guidance from faculty, staff, graduate students, and undergraduates.

The new curriculum required a change in teaching methodology, as well as subject matter. The teachers were accustomed to using a teacher-centered lecture model, but have now adopted a student-centered laboratory model. The new curriculum is goal-oriented. A project (for instance, a multimedia presentation) is assigned, and the students have to locate the tools and develop the skills to complete it.

The change in teaching style has brought about a change in the students' learning style. Students are taking responsibility for their own learning. For instance, though they at first scoffed at the shelf of resource books available for their use, now they use the books routinely. Also, the students are spontaneously engaging in cooperative learning. One student will discover a technique (for instance, how to add original art to a piece of clip art), and the idea will propagate through the class. The teachers foster cooperative learning in several ways: (1) they permit interaction during class; (2) they have students demo their projects and explain their techniques to the class; and (3) they get students out of their normal competitive mode by evaluating projects against a clear standard rather than against each other.

The teachers speak of the technology transfer and of their involvement in bringing the new curriculum into being as a "rejuvenation" that has enabled them to renew their commitment to teaching. It gives them a sense of "feeling important" and "doing something valuable." Both of them teach math classes as well as the new computer curriculum. They report that the lab course has caused them to evaluate their teaching of math. One teacher says, "It's going to change my teaching style" in general. The other says, "The interaction with students [in the lab] has changed my philosophy," resulting in more positive interaction with her math students.

Five student aides (two girls and three boys), all of whom are enrolled in the computer science curriculum at the high school, volunteered their time during the summer to come to UMass Lowell to learn how to maintain the lab's new hardware and software. The technology transfer was carried out by University faculty, staff, graduate students and undergraduates.

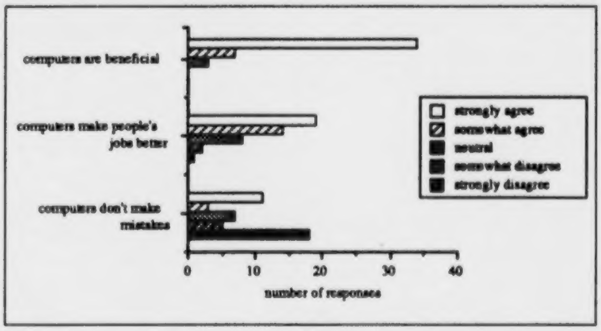

Figure 5. Some student beliefs about technology. Students were asked to indicate the degree to which they disagreed or agreed with certain statements, on a five-point scale from "strongly disagree" to "strongly agree." Responses to three opinion questions are shown.

Contribute to making Westford a community where learning can flourish. Our approach to reaching this goal is to keep townspeople informed about the project and to involve as many townspeople as possible in it. Our public relations efforts include a newsletter distributed to all households in Westford. The project has also achieved visibility through news stories in newspapers such as the Lowell Sun and the Boston Globe. Efforts to involve townspeople in the project include opening the computer lab to the community from 2:00 to 7:00 pm four days a week. A recent meeting for volunteers from the community who were willing to help staff the lab during those hours drew 25 townspeople. A speaker series is also under way. Townspeople are being invited to speak to students about how they use computers in their jobs. The Westford Partnership has its own outreach and publicity efforts, as well.

Increase students' sensitivity to the effects of computerization on society. We are concerned that students glorify computer technology. We want them to view technology as a tool, and to see that there are ethical implications to how the tool is used. Our approach to dealing with ethical issues is to give the students thought-provoking books to read, have them do a project about the effects of computerization, engage them in discussion of ethical issues, and demonstrate by example the ethical use of computers.

The students will read *The Electronic Sweatshop* [Garson 1988] and *The Cuckoo's Egg* [Stoll 1989]. They will create a multimedia presentation, based on a Garson-style interview, about how computerization has affected the workplace of someone they know. They will participate in discussions about issues such as privacy and computer theft. In addition, lab staff will set a good example by prohibiting pirated software in the lab and following other suggestions from Searls [Searls 1988].

We surveyed students about some of their beliefs concerning computer technology. We asked them to indicate their degree of agreement with various statements on a 5-point scale. The majority of students believe that computers make people's jobs better or are neutral on the issue. Students are fairly evenly divided on the question of the infallibility of computers. An overwhelming majority strongly agree with the statement that "computers are beneficial" (see Figure 5). We will re-survey students about these beliefs at the end of the school year. We hypothesize that familiarization with the complex issues of the effects of computers on society will cause some students to back off from their extreme positions on these issues.

Plans for Dissemination

Our pilot program could not have happened without the coalition of teachers, the Partnership, and the University. In a strictly pragmatic sense, the technology transfer from the University will not do a town much good without the hardware and software to implement it, the commitment from the teachers to adopt it, and the resources of the community to support it. Thus, our plans for propagating the program's successes to other towns are focused on establishing such coalitions.

We are currently seeking funds to establish, at UMass Lowell, a clearinghouse of information about how to set up such coalitions, and in particular how to establish a town partnership on the model of the Westford Partnership. The clearinghouse will offer information and consulting to nascent partnerships.

We are confident that other communities will be interested in coalitions like ours because of the publicity that the project has generated and the response to that publicity. For instance, a mention of the project in *USA Today* netted us 66 inquiries so far, from communities across the United States [*USA Today* 1991].

Further Assessment

Our next report will be an end-of-the-school-year assessment of the first year of the new program. The assessment will include: (1) next year's enrollment figures; (2) a follow-up survey of students' interests and beliefs; (3) follow-up interviews with the teachers; (4) analysis of the after-hours use of the lab; and (5) comparison of final exam, project, and AP test results with previous years'.

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Paper (T4-07)

Computer Science Education in Prison: Challenge and Opportunity

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Abstract

Wilmington College has offered associate and baccalaureate degrees in computer science at Ohio's Lebanon Correctional Institution for almost a decade. Although nationally there has been a trend toward declining undergraduate computer science enrollment, the numbers in this program have been fairly steady. During this same decade, the political correctness of federal funding for social programs has developed and now threatens to dismantle the entire collegiate correctional education system. The debate over federal educational assistance to incarcerated persons has become a popular political topic. This paper describes the computer science curriculum at the Lebanon campus and discusses the problems and challenges of teaching in this program. It also seeks to heighten public awareness of the political debate.

Background

Wilmington College, founded in southwest Ohio in 1870, is affiliated with the Religious Society of Friends. The Quaker heritage of concern for peace, international education, and social justice are integral parts of campus life. The curriculum, the governance structure, and a variety special and non-traditional programs reflect these values.

The commitment of Wilmington College to education in Ohio's prisons dates from 1968. The first programs were non-credit skills courses. In 1975, the College received a contract from the Ohio Department of Rehabilitation and Corrections to offer Associate degrees in several areas at the Lebanon Correctional Institution. Ten years later Wilmington College initiated the first in-house Baccalaureate programs in an Ohio prison. Majors are now offered in Computer Science, Sociology, Management, Marketing, and Psychology.

To be admitted to the program, an inmate must have a regular parole hearing date within nine years of the beginning of his first semester. Because transfers to other institutions and earlier parole hearings happen frequently, most students first seek an Associate degree. Some 380-390 inmates participate in the college programs in each of the three full semesters conducted annually. (Courses leading to a B.A. in Criminal Justice are also conducted for correctional officers at the facility.)

Student demographics are a mirror of the institution's 2500 inmates. Figures released in 1990 showed a racial mix of 55% Black, 45% Caucasian. Average age is slightly over 30 years. Roughly 60% of the population is serving time for some types of homicides or attempted homicide, rape, a drug offense, or aggravated robbery (Rice, 1990). However, classroom conduct reflects little of these violent backgrounds. Instructors neither inquire about their students' convictions nor, frankly, want to know. In this case, ignorance ensures equal treatment.

All inmates have assigned "jobs." Those who choose college as their work assignment are a decidedly more motivated group than the general population. Completing a college degree gives them a strong positive when appearing before the parole board. Even more important, they see the college degree just traditional students do: as a ticket to a job and a future. Because the recidivism rate declines to 11% for college-graduate men (Moke & Holloway, 1986), this is a reasonable expectation.

Wilmington College maintains a single catalog. Consequently, all campuses use the same courses, and all degrees meet the same requirements. No special consideration is given for the unusual circumstances of prison life. Staffing with a large number of adjuncts complicates the maintenance of consistent standards, but the problem is discussed at frequent meetings of all teaching faculty.

Computer Science Program

Two fulltime and 4-6 adjuncts per semester offer the computer science curriculum to approximately 100 majors and minors. The associate and baccalaureate programs (major and minor) require completion of a four-course core with at least a 3.0 average. The associate degree and minor both require an additional ten hours; all hours for the minor must be upper division.

To achieve breadth in computer science, majors are required to complete the following areas of study:

Introduction to Computer Science I (total of 7 sem. hrs)
Digital Logic (3 sem. hrs)
Assembly Language Programming (4 sem. hrs)
Software Engineering Concepts (3 sem. hrs)
Operating Systems (3 sem. hrs)
Software Engineering Project (3 sem. hrs)
One additional programming language
Discrete Mathematics

Depth in the discipline is provided by completion at least ten hours of departmental electives. The sequence *Data Structures-Compiler Design-Computer Architecture and Organization-Artificial Intelligence* focuses on the more traditional areas of computer science. The sequence *COBOL-Systems Analysis-Database Program Development* emphasizes information systems and management.

Facilities

The Lebanon campus does not have access to a mainframe. Computing work is done on two dozen DOS-based microcomputers, a mixture of XT and AT models. Inmate possession of software and use of computers are severely restricted by prison regulation, and computers are only available in the college lab. These restrictions actually work to the students' advantage.

Teaching Considerations

In "normal" classes, instructors must constantly push the idea of planning before coding. The trivial nature of many early programming assignments actually works against these admonitions. When more complex assignments, those for which planning is a really critical part of the development process, arise, students are too often unable to adequately balance the design and coding processes. Consequently, they spend far too much time debugging design flaws. Inmate students are allowed only two hours per week of computer access for each programming course taken. They cannot afford the luxury of creating at the keyboard and debugging at leisure. Techniques for designing, pseudocoding, and hand-testing solutions are quickly developed and consistently applied.

The differences one does find between inmate and mainstream students are attributable to two factors: maturity and precollege preparation. As noted above, the average age of the inmates is 30.6 years. This is more typical of a community college or evening college student body than of the usual undergraduate computer science group. The experiences and lifestyles of the inmate students have left them with a quality perhaps best described as "streetwiseness."

This trait often reveals itself in classroom discussions. The Lebanon students get to the core of a problem very quickly, often without realizing they are doing so. Their questions and comments often address substantive issues in naive ways. For instructors this provides a constant challenge. Lack of instructor preparation is punished by a very uncomfortable class session. This is, after all, an environment in which heavy-handed tactics do not work at all and in which an invitation to indulge in independent thought is a welcome change. These students read manuals and reference material like professional programmers. They are constantly evaluating their results and modifying their techniques. They do not seem content to have a program working; there is a general desire to find a more elegant solution. For those used to teaching only mainstream undergraduates, this may seem like hyperbole. Be assured it is not. The teaching faculty have consistently rated this inquisitiveness as the greatest advantage and most distinct challenge they have to face in the prison classroom.

The balancing factor is the students' academic preparation. To qualify for admission to Wilmington College, all students must have completed high school. Although 75% of the students at Lebanon have earned diplomas in the normal way, most are "social pass-alongs" (Moke & Holloway, 1985). Over fifty percent of the students read below the tenth-grade level. Over eighty percent have math skills below the tenth-grade level. Over ninety percent have language skills below tenth-grade level. Given the inherent mathematical and logical foundations of computer science theory, the challenge to instructors is obvious. Because course material is not diluted in any way, inmates use the same textbooks as main campus students, who have much better academic preparation. Fundamental textbooks are used, such as Sedgewick's *Algorithms* (Sedgewick, 1988), Aho, Sethi, and Ullman's *Compilers* (Aho, Sethi, & Ullman, 1986), and Fairley's *Software Engineering Concepts* (Fairley, 1985). Basic texts in their areas, each contains material which can be difficult for many of the Lebanon students to understand. Instructors expend a great deal of effort reinforcing concepts and, in some cases, teaching basic skills. Elementary interpretive skills cannot be assumed. The reward, of course, is in detecting mastery when it occurs.

Funding Correctional Education

On July 30, 1991, Senator Jesse Helms introduced an amendment to the *Commerce Justice Appropriations Bill* which would deny inmate eligibility to Pell Grants. This vote was repeated on September 12, 1991, in the form of an amendment to the *Labor, Health and Human Services Appropriations Bill for Fiscal 1992*. The US Senate's opposition to inmate use of Pell Grants was based on the premise that public assistance for college students should not go to those who break criminal law. This reasoning adopts a view that eligibility to the grants constitutes a reward for socially inappropriate behavior. Advocates of correctional education responded to these arguments by establishing the link between correctional education and successful offender reintegration into society. Three major studies of parolees who received college education while in prison establish this link (Moke & Holloway, 1986; U.S. Department of Justice Bureau of Justice Statistics, 1987a; U.S. Department of Justice Bureau of Justice Statistics, 1987b).

The Justice and Labor bills emerged from joint committee without the restrictions. In February, 1992, the Senate passed the *Higher Education Reauthorization Bill*. Inmate use of Pell Grant funding was not restricted. However, a limitation was placed on the percentage of incarcerated students who could receive the funding at a college. Action by the House of Representatives is pending; final action and presidential consideration should occur by June, 1992.

Two policy arguments have arisen over the inmate eligibility issue. The first is one of educational policy. Does society seek to deter people from crime by keeping them ignorant?

Tying Pell Grant eligibility to offender status mixes criminal sentencing policy with educational policy. The studies cited above clearly detail the positive effect of higher education on reduced recidivism. The second policy is one of correctional management: educational programs help wardens run prisons more effectively by reducing idleness. As noted above, every inmate at Lebanon has an assigned job (janitor, metal worker, clerk, etc.). Attending college is deliberately included as one of the assignments for this very reason.

Finally, there is a practical economic policy issue. Investing in correctional education helps society avoid future costs of reincarceration. By comparison college education is a far less expensive alternative. College education helps offenders become law-abiding taxpayers rather than tax-users by assisting them in developing meaningful employment skills.

Conclusion

The computer science program at the Lebanon campus has been and continues to be a challenging pedagogical experience. The entire Wilmington College effort in correctional education has succeeded because of a strong coalition between the college's administration, the teaching faculty, and the Ohio Department of Corrections. All parties recognize the positive effects of the programs and are committed to their success.

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Projects (T4-08)
International Perspectives

Computer Education Overseas in the United Arab Emirates

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Abstract

In 1990, the United Arab Emirates University began a new program, the Basic University Education Center, designed to raise the performance level of students in selected curriculum areas. All incoming students must complete the one year program before continuing to regular University studies. Students in the BUEC advance through courses in English, Mathmatics, Computer Applications, and Arabic. Most of the students have not worked with computers before entering the University, and have varying mastery levels of English. Aided by a state of the art computer system, classrooms are designed to guide students through the curriculum by making use of various multi-media options. A unique teacher monitoring system enables the instructor to have a constant awareness of each student's progress or problem area. The curriculum ranges from basic skills [Numerical Computations, Keyboarding, Word Processing, Spoken English Comprehension, Reading Fundamentals] to more complex concepts [Algebra, Pre-Calculus, Problem Solving, Statistics, Spreadsheets, Databases, Programming, Graphics, Advanced Reading Skills, Research, Literature]. The combination of proficiency-based course scheduling, multi-media format, computer-generated exercises, and the computer monitoring system has provided a new and effective multi-disciplined approach to computer-assisted learning and assessment. Pre- and post-assessment scores confirm the student's noteworthy progress.

Algorithmic Thinking and Problem Solving: A Russian Alternative to Logo

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Abstract

The Young Programmer's School (grades 4-8), organized by the Lincoln Public Schools and the University of Nebraska-Lincoln, has implemented an approach that has been used for six years in the former Soviet Union, as a part of the IBM "Pilot Schools" project.

The primary goal of this project is to teach students to solve "real world" problems by:

- creating computer models,
- presenting solutions in the form of algorithms,
- conducting computer experiments based upon these models and algorithms.

To achieve this goal, FORWARE SYSTEMS designed special software: Roo & Robby and SchoolWorks. The use of these tools has demonstrated that they:

- are highly motivating and provide students with Nintendo-like environments,
- require minimal training even for young students,
- help teachers individualize instruction. Each tool contains an animated "tutor" who formulates problems and examines solutions.

This project received a very positive review in *PC/Computing* and has been successfully used in Russia with more than 750,000 copies of the textbook being used in over 350 school districts. The materials can be used in mathematics and science courses in which problem solving is the focus. Recent experiences with U.S. students and teachers have confirmed the value and appropriateness of this project.

English Approaches to Pupil Empowerment

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Abstract

England and Wales have introduced a National Curriculum which defines statutory student entitlements to a range of learning experiences with computers.

These include: the use of computers to compose music, communicate, log data, sense remotely, prepare computer graphics; and obvious applications to the curriculum such as the use of databases, spreadsheets, modelling, simulations, desk top publishing, and CAD, in a wide range of subject areas.

All children must be given opportunities for such learning, and every teacher in every curriculum area will be expected to use computers in their teaching. Children must develop IT capability, i.e., the ability to apply ideas and methods concerning IT to any ongoing activity, as appropriate.

The STAC project was set up to identify and help solve some of the problems posed for individual teachers, for schools, and for school district support services, and has developed materials for use at national, school district, and school levels.

The project session offers an opportunity to view some of our materials, including: maps of computer applications in every curriculum subject; support for school district support services; documents to help school planning and strategy; advice on teacher professional development, and in-class support; and analyses of the experiences of student teachers.

Effect of Primary School Computer Use on Japanese Learner Attitudes

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Abstract

This study investigated the changes in attitudes of Japanese first- and second-grade children who were exposed to microcomputers in school. Eight hundred and three, first- and second-grade children were selected from six Japanese public schools. Approximately half of the subjects were selected from urban, suburban, and rural schools using computers, while the remaining subjects were from schools not using computers.

The Young Children's Computer Inventory was the instrument used for this study. It was derived from a questionnaire originally developed at the Tokyo Institute of Technology, and contained four subscales: Attitudes Toward Computers, Motivation to Study, Empathy, and Creativity.

Results add cross-cultural support to existing U.S. evidence that students who use computers tend to like them more than students who do not use them. Findings also support the hypothesis that the use of computers has no negative effect on children's empathy. Findings fail to provide evidence that computer use improves intellectual activities such as creativity and the desire to study.

Projects (T4-09)

Teaching with Interactive Video

Teacher-Made Interactive Media Using Repurposed Entertainment Videodisks

James Burney
University of North Alabama
Florence, Alabama

Abstract

Abstract not available at press time.

Teaching Interactive Video Design & Production to Teachers

Penny Semrau
California State University, Los Angeles
Los Angeles, California

Abstract

Course Overview: This session will cover a class taught at California State University-Los Angeles entitled *Interactive Video Design & Production*. Producing an interactive videodisc during a 10 week quarter required that the graduate students work cooperatively in 5 teams of expertise: instructional designers, software authors, scriptwriters, graphic designers, and video/audio producers.

Course Goals: The instructional goals included:

- Participate in the design, development, and production of an interactive videodisc.
- Apply instructional design principles in the creation of an interactive videodisc.
- Define the objectives, target audience, and delivery platform.
- Research the content area.
- Write a treatment and script describing the entire interactive videodisc.
- Create a storyboard illustrating still frames, text and graphic overlays, video sequences, audio lay downs, and all software screens including menus, sub-menus, animations, and text.
- Develop a flowchart specifying the links between the various content modules, navigational paths, menus, and the kinds of interactivity.
- Manage your team's responsibilities within the 10 week quarter and resource constraints.
- Evaluate and revise the project at various stages.
- Provide an university wide presentation of the finished interactive videodisc.

Recommendations: Guidelines for the successful implementation of a videodisc production class will be covered. The strengths and weaknesses the finished videodisc will be discussed.

Multimedia and Thinking Skills in the Restructured Classroom

Peggy Healy Stearns
State University of New York at Buffalo
Buffalo, New York

Abstract

Multimedia can be a powerful tool for encouraging the development of critical thinking skills within the context of the curriculum. Because most multimedia resources are actually large databases which include text, graphics, sound, and video, they provide students with motivating environments and powerful tools for gathering, organizing, analyzing, and communicating information - all important Information Age thinking skills.

Access to multimedia resources encourages students to become active participants in the learning process and provides many opportunities for cooperative learning. Most multimedia resources also facilitate cross-curricular integration. These advantages suggest an important role for multimedia in restructuring education.

This session will address the role of multimedia as a tool for developing critical thinking skills and will highlight its potential in the restructured classroom. The presenter will demonstrate multimedia resources that can support these goals.

Interactive Video Lessons for Teaching Cultural Literacy

Barbara Ann Boyer and Penny Semrau
California State University, Los Angeles
Los Angeles, California

Abstract

Background. The use of instructional software and interactive videodiscs can be a powerful media in the classroom. Much like television, software and interactive videodiscs impacts on the values, attitudes, and beliefs of students. The interactive videodisc can be a transmitter of culture—not simply a neutral storage and retrieval machine. At a time when classrooms are becoming increasingly multicultural, it is important that both teachers and students be sensitive and aware of the role technology plays in transmitting cultural values (Boyer & Semrau, 1992). Cultural literacy is not a concept that has been widely promoted in educational software and it is difficult to find educational software customized to the varied needs of the multicultural classroom. Therefore, it is important that teachers understand how to repurpose and structure lessons for videodiscs already on the market.

Interactive Video Lessons. Our research provides a theoretical base and further develops cultural literacy lessons for use with popular interactive video programs. These lessons concentrate on critical thinking, cultural influences, and relationships of the subject content to the students' own culture. We demonstrate how higher level thinking skills can be developed through cooperative learning teams as well as individual and large class approaches.

Projects (T4-10)
Technology for Students with Learning Disabilities

Computer Writing Buddies or Cooperative Learning, Computers and the Learning Disabled Student

Carol Utay
Shelton School
Dallas, Texas

Abstract

An inadvertent discovery was made when two classes converged upon the computer lab at the same time. One class consisted of eighth graders and the other, sixth graders, both at the lab for creative word processing. Rather than sending one class back to their classroom both stayed in the computer lab. The results were amazing. Since that first 'Buddy" writing day we have implemented a cooperative learning, computer writing program. The research supports this teaching technology and the results are outstanding.

Computers are now accepted as a necessary, inescapable part life (Kurland, & Kurland, 1987) and an integral part of education (Moore, 1989). By 1986, approximately 80% of schools using computers had word processors available (TALMIS, 1986). In 1987 there were more than 1,600,000 microcomputers in elementary schools (Barbour, 1987). Computers are often used in classrooms to improve the writing skills of students in general (Kane, 1983), and writing skills deficits of learning disabled students in particular (Moyles, & Newell, 1982). As part of the English/Composition class at the June Shelton School and Evaluation Center, a private school for children with learning disabilities, students are taught the basics of word processing and how to apply them to school assignments.

Voice Recognition Technology as a Tool for Learning Disabled Students

Keith Wetzel
Arizona State University, West
Phoenix, Arizona

Abstract

Can voice recognition technology be used to help learning disabled students overcome difficulties with written communication? This study proposes to take the first steps to answer that question. It will describe the attempts of two such students (one fourth and one eighth grader) to learn and employ the technology for written school work. It is a descriptive case study.

The subjects display written language deficiencies, but normal spoken speech, so that on the basis of oral participation in class they are indistinguishable from other students. However, their written work is often several years below that of their peers.

The study will focus on two areas. First, it will provide a description of the elementary students learning to use the technology including the amount of training, and the speed and accuracy students achieve at the end of the training period. Second, it will describe the student's use of technology to accomplish written composition based on the researcher's observations over 15 weeks, and an evaluation of the length and quality of their compositions. In addition the researcher will interview teachers and students to determine their attitudes toward the use of the technology, and its possible effects on student motivation to write.

AADvantage for Students with Learning Disabilities

Janis Bing
Education Service Center, Region VI
Huntsville, Texas

Abstract

This presentation will share the results of research dealing with adaptive technology and literacy development of students with learning disabilities. A whole language process using verbal language, reading, and written language was used. Adaptive technology consisted of a computer, word processing software, a speech synthesizer, and a printer. Local campus teams consisting of an administrator, a mainstream teacher, and special education resource teacher were trained in the use of adaptive equipment and teaching modifications. In initial research, professionals conducted fifteen sessions with identified learning disabled students. Follow-through research involved prolonged use of the model and a control group. This project began in June of 1991 and ended in May of 1992.

Projects (T4-11)
Technical Aspects of Telecommunications

Help! Comparison Shopping for Modems

Dee Dreyer
Denton Independent School District
Denton, Texas

Abstract

Many times the list of features in modem ads only adds to the confusion in purchasing one. This session will describe the basics to look for in a modem that fits your needs. Participants will discuss sources, speed options, Hayes compatibility, price, warranty, internal vs external, and what I call "extras." Learn how to increase your buying power in this age of telecommunications.

Alice: Telecomputing Software for Education

Robert Tinker
TERC
Cambridge, Massachusetts

Abstract

Alice is user and host software under development at TERC that has been designed to meet the needs of education. Through extensive experience in educational telecompuitng and careful consultation with educators, six design requirements were identified which are necessary and sufficient for telecompuitng to realize its potential in education. These are:

- Good user interface. All functions must be intuitive and easy to use.
- Beyond text. Graphics and data must be easily shared on the network.
- Support of commercial services. Packaged educational services must be available.
- Interconnection. Educational users should be able to reach each other through the Internet.
- Low cost. Telecommunications and software costs must be minimized.

For educational telecompuitng to become an important force in education, it is essential that each of these requirements be fulfilled. Alice is a major break with present telecommunications software design because it is the first package to meet these goals.

Implementing an Educational BBS: Technical and Instructional Considerations

Vance A. Durrington, Donna Everett and Judi Repman
Texas Tech University
Lubbock, Texas

Abstract

In 1990, writing in The Complete Handbook of Personal Computer Communications: The Bible of the Online World (3rd ed), Alfred Glossbrenner estimated that over 10 million computer users worldwide were using electronic bulletin board systems (BBS). In Austin, Texas alone it has been estimated that there are 194 BBS in operation. In this presentation the potential of electronic bulletin board systems in educational environments will be examined. Technical as well as instructional considerations will be presented.

The first part of the presentation will focus on technical considerations required as part of establishing an educational BBS. Selection of software and hardware will be discussed, along with issues such as the importance of the SysOp and system maintenance and security.

Utilizing a BBS to support instruction and for community outreach will be discussed during the second part of the presentation. The BBS can be used for person-to-person communication as well as for group interaction. Suggested activities, such as discussion groups, description of class assignments, and e-mail, will be discussed. Access to the BBS by the community at large will also be highlighted.

Electronic Mail and TENET

George Bigham
West Des Moines, Iowa

Abstract

Abstract not available at press time

Projects (T4-12)
Language Arts

Texas Aware/Telecommunications and the Writing Process

Darylann Hansen and Tillie Hickman
Beaumont Independent School District
Beaumont, Texas

Abstract

Students at Central Senior High School and West Brook Senior High School in the Beaumont Independent School District learn strategies for developing communication skills in order to become a part of a sophisticated and well-educated workforce that demonstrates the technological literacy which is an essential prerequisite for successful competition in the world marketplace.

Impact on Student Achievement: This telecommunications project encourages students to communicate with other students, to solve problems, to think innovatively, and to become lifelong learners. Shifting to a student-centered learning environment improves students' academic achievement and, thereby, their writing skills. The district objectives of proofreading, fluency, and elaboration improve as students communicate with other students they know only through telecommunications. Furthermore, students' attendance increases because of their involvement in this project. Telecomputing activities help low-achieving students to develop, to contribute ideas, and to show gains in academic achievement.

Impact on Staff Effectiveness: Because teachers are the key to success in any educational change, they must be trained and supported in implementing new technologies. When developing creative classroom strategies for the Telecommunications and Writing Process project, teachers begin to better understand school structures, curriculum, teaching, and learning. Once telecommunication facilities are available, instructional techniques become more effective and technology is managed more efficiently. Teachers serve as role models for the students dealing with change in the technological/informational global society.

The Warp and Woof of Language Arts: Technology and Literature

Shelley B. Wepner
The William Patterson College of New Jersey
Scotch Plains, New Jersey

Abstract

The purpose of this project is to determine the effectiveness of combining educational software with theme-related, literature-based plans by analyzing: (1) teachers' attitudes toward integrating technology with literature-based reading; and (2) students' attitudes toward reading and themselves as readers. Three third-grade classroom teachers and one elementary reading specialist are participating. Teachers are being provided with a structured mechanism for integrating technology and class sets of trade books into their whole-class instruction. Teachers are spending the first 2-3 days working with software. They are spending 1-2 weeks working with a trade book and its accompanying literature-based plan, utilizing all the instructional strategies contained therein. Software, serving as a segue into literature-based reading, uses real student concerns, issues, problems, and insights as a basis for thematic stories on students' school-related problems, familial concerns, and personal feelings. Each realistic fiction trade book deals with the exact same issues contained in the software. Pre-post observational, survey, and interview data are being collected to indicate the degree to which teachers' attitudes change toward using technology with literature-based reading and the degree to which students' attitudes change toward reading and themselves as readers. Insights about this on-site participatory project and the type of data being collected will be reported.

Teaching Literature with Technology

Janice Kelso
The Woodlands, Texas

Abstract

During the year juniors in one class had daily access to the TEC-Lab for a course in American Literature. These students were introduced to various technological devices to improve their writing skills and produce projects to show their understanding of literary selections. This class was compared in a variety of ways to another class taught by the same teacher in a more traditional way.

Some of the projects developed over the year included video presentations, desk-top publishing and data-base creation. CD-ROM was used to help with the research for the major junior paper. Scanners were used to create a file of pictures to illustrate poetry the students wrote or selected. Some of the difficulties encountered were in grading, time constraints and technology overload for some students.

This project is part of a grant involving four other teachers in math, science, social studies and communications. It will continue next year with each teacher having access to the lab one day each week for all classes enabling us to compare the approaches and see which is more effective.

Teaching Research and Communication Skills in an Interdisciplinary Project-Based Curriculum

Sharon M. Carver and Paula Jones
University of Rochester
Rochester, New York

Nancy Giuliano
Charlotte Middle School
Rochester, New York

Abstract

The *Year of Discovery* project involves integrating computer technology across the academic curriculum. Our eighth grade students work collaboratively during extended time blocks on large-scale projects addressing community issues. The curriculum places priority on learning general research and communication skills, i.e., skills for posing questions, collecting and organizing information, developing oral, written, and HyperCard presentations, and evaluating the process. Math, science, social studies, and English teachers collaborate to introduce subject area concepts and help students apply them to on-going projects.

The *Year of Discovery* project also involves a unique collaboration between a school, a university, and a local business. A University research team coordinates curriculum development and provides computer support (e.g., maintaining the network). The research team also facilitates assessment by developing scoring systems, maintaining a student database, organizing student portfolios, and videotaping student presentations. Kodak employees from the Business Research division both collaborate with teachers and serve as consultants/mentors to student project groups.

At the project session, we will briefly describe these aspects of the project. Our handouts will include a fuller description of the goals, structure, and methods of the project, the Research and Communication Skills scoring rubrics, and sample student work.

Special Presentation–ACM/SIGCSE (T4-13)

ACM Model High School Computer Science Curriculum

Abstract

A Task Force of the Pre-College Committee of the Education Board of the ACM has worked for several years on the development of a model high school computer science course. A draft report was distributed at NECC '91 in June, 1991 in Phoenix, Arizona. This draft was revised and sent out for reviews in November.

The draft report provides a list of topics to be included in the course. The major areas are: Algorithms, Programming Languages, Operating Systems and User Support, Computer Architecture, Social, Ethical and Professional Context, Computer Applications, and Advanced Topics.

The report also discusses the motivation for the proposal, laboratories and exercises, and important computer science high school issues. A sample course outline, dividing the material into modules, is contained in an appendix.

The panel will present an outline of the report and an analysis of the reviews.

Task Force Members:

Susan M. Merritt
Pace University
New York, New York

Charles J. Bruen
Bergenfield High School
Bergenfield, New Jersey

J. Philip East
University of Northern Iowa
Cedar Falls Iowa

Darlene Grantham
Montgomery County Public Schools
Baltimore, Maryland

Chuck Rice
Dalton School,
New York, New York

Viera K. Proulx
Northeastern University
Boston, Massachusetts

Gerry Segal
Bank Street College of Education
New York, New York

Carol Wolf
Pace University
New York, New York

Wednesday

NECC '92 CONFERENCE PROCEEDINGS

Special Window (W1-01)
Interactive: The Old-Fashioned Way

Tom Snyder
Tom Snyder Productions
Cambridge, Massachusetts

Abstract

Interaction among teacher, student, and parent is far more important than any of the mythical interaction between person and machine. The teacher must forever remain in the interactive loop. This session will highlight strategies that use technology as a catalyst for true, essential human interactivity.

Special Presentation–Panel (W1-02)

ITEC Project: Technology and Higher-Level Cognitive Functions

Moderators:
Violeta Tzoneva
National Neuroscience and Behaviour Research Programme
Sofia, Bulgaria

Betty Collis
University of Twente
The Netherlands

Abstract

The ITEC Project (Information Technology in Education and Children) Panel focuses on the impact of computer use on the higher-order cognitive functions of students (aged 9 to 12). The ITEC Project is a multinational investigation of the effects of classroom computer use on children. Indications of interactions and types of computer use will be discussed. A descriptive and analytic profile of the typical "Teacher-Student" and "Student-Student" interactions at school lessons with computer use is presented. These results are based mainly on the analysis of videos presenting lessons in a variety of school subjects, software use, frequency of computer use, organization of the teaching/learning process, physical setting of the classroom, etc. (the analysis was performed by Bulgarian experts in 1990-1991 with a coding sheet of mapping sentences as an instrument for evaluation of different aspects of computer use in the classroom) as well as on ITEC Project written reports.

Panelists:

Kwok-Wing Lai
Department of Education, University of Otago
New Zealand

Marco Muray-Lasso
Mexican Academy of Science
Mexico City, Mexico

Vitaly Rubtsov
Institute of General and Pedagogic Psychology
Russia

Takashi Sakamoto
The Graduate School of Nagatsuta, Tokyo Institute of Technology
Tokyo, Japan

ADAPT Spotlight (W1-03)
I Can Do It Myself

Bob Keller
Don Johnson Developmental Equipment
Wauconda, Illinois

Abstract

Special software enables students with disabilities to do the same work on the computer as the rest of the class. The powerful word prediction programs *PredictIt* (Apple IIe/IIGS) and *Co-Writer* (Macintosh) help students write beyond their mechanical abilities.

Special Presentation Panel (W1-04)

Accreditation Standards for Educational Computing and Technology Teacher Preparation Programs

Abstract

This session presents the standards and guidelines developed by the International Society for Technology in Education (ISTE) Accreditation Committee for evaluation of teacher preparation programs in educational computing and technology. These guidelines address the standards and criteria that were approved by the national Council for Accreditation of Teacher Education (NCATE) in 1991 and those that will be submitted for review in the Fall of 1992.

Accreditation standards for the Computer/Technology Literacy endorsement and Educational Computing and Technology Leadership master's program are discussed and examples of activities meeting the standards given. Also presented are suggested changes in standards for all teacher education programs (Unit Accreditation Guidelines) and for preparing teachers of secondary Computer Science.

Panelists:

Lajeane Thomas–ISTE Accreditation Committee Chair
ISTE Representative to NCATE Board
Louisiana Tech University
Ruston, Louisiana

Joyce Friske–NCATE Board of Examiners
Oklahoma State University
Stillwater, Oklahoma

Don Knezek–ISTE Accreditation Committee
Education Service Center–Region 20
San Antonio, Texas

Sally Sloan–ISTE Accreditation Committee
Winona State University
Winona, Minnesota

Harriet Taylor–ISTE Accreditation Committee
Louisiana State University
Baton Rouge, Louisiana

James Wiebe–NCATE Board of Examiners
California State University, Los Angeles
Los Angeles, California

Projects (W1-05)
Distance Learning

Distance Learning Modules Share Expensive Resources

Inabeth Miller and Beth Lowd
Massachusetts Corporation for Educational Telecommunications (MCET)
Cambridge, Massachusetts

Abstract

The Mass LearnPike, MCET's distance learning network, and its companion computer network, the Mass LearnNet, bring into the classroom resources that schools can provide in no other way. MCET of short modules, 3-5 sessions, that help a teacher introduce her class to new experiences and ideas and to role models they might not otherwise meet. Using cordless telephones and 800 numbers, students interact with the personalities on the television screen. All of MCET's programs are live and interactive, delivered by satellite to schools all over the state.

The Mass LearnNet supplements the intention of the programs with conferencing and electronic mail among participants between sessions. It also allows users to register for programs and enter evaluations.

Presenters will show brief video clips of programs and report on evaluative data from the distance learning programs and computer networks.

Satellite Data Transmission To Enhance Distance Learning

Teresa Van Haalen
Educational Service District 101
Spokane, Washington

Abstract

Timely evaluation of student performance has been recognized by learning theorists to be critical to all aspects of content retention. Increasing automaticity and diagnosing misunderstandings are important components of effective teaching. Oftentimes, this aspect of the instructional process is missing when subject matter delivery is conducted via television. Even an interactive distance learning environment often lacks immediacy of feedback (Winne, 1985). Traditional transmission of student materials via mail delivery is often slow and expensive (Linking for learning: A new course for education, 1989). This project describes the data transmission link under way within the Pacific Northwest Star Schools Partnership. A unique feature of this Star Schools grant is two-way data transmission, allowing for 48 hour turn-around time on homework assignments and tests.

Collaboration such as now exists among Education District 101's Satellite Telecommunications Educational Programming (STEP), Apple computer, the state boards of education of Alaska, Idaho, Washington, Oregon, and Montana, and RXL Communications greatly enhance our ability to bring the most current and educationally relevant technologies into the classroom.

Technology in the Isolated Rural Elementary School

James Chiavacci
University of Maine
Orono, Maine

M.S. Vijay Kumar
Mt. Holyoke College
South Hadley, Massachusetts

Diana O'Neal
Wesley Elementary School
Orono, Maine

Abstract

This presentation will describe the process of, and the products from, the development of a model for using computer related technology to enhance instruction in a small isolated school. The presenters will detail the objectives established for the project at its outset and to what extent they were met or exceeded. The presentation will also include the curriculum/instructional sequences developed for the subject areas. It will demonstrate that small schools have the most to gain by the use of technology. They do not have extensive educational resources within their schools and communities. Technology can bring in the outside world by "extending" the walls of the school. Technology can go a long way to compensate for some of the built-in disparities with more centrally located schools, and can equalize access to resources.

Paper (W1-06)
Of What Earthly Use is a Computer Program to a Quilter? and Who Else Can Use the Program Once it Has Been Written?

Elizabeth S. Adams
Hood College
Frederick, Maryland

Abstract

This paper describes how a computer program, originally conceived of as an aid to a quilter wanting to create a Log Cabin Quilt, can be used in a variety of educational settings. It illustrates possibilities for interaction between technology and art. It suggests some ways in which a computer program can be used as a tool: by students studying color theory or basic design in an art department; by students studying user interfaces, computer graphics, or software maintenance in a computer science department; by students designing experiments in a psychology department; and by those for whom the program was originally created, the Log Cabin quilters.

Introduction

Before I took up computer science, I was a quilter. In the mid 1980s, while I was in the midst of struggling with the task of making a quilt, I enrolled in a computer graphics course. Thus it was natural, when I started to think about the possibilities for a project in the course, that I would think about how a computer could be used to help a quilter. I remembered the difficulties I had had in selecting the fabrics for my quilt and in deciding how to put them together. I remembered how hard it was to envision what the quilt would look like when I was done. I remembered how I had longed for the ability to magically create multiple drawings of my proposed block so that I could lay them out and see how the finished quilt would look before starting it. As I remembered I realized that I had the rudimentary specifications for my graphics project.

I chose the *Log Cabin* for my basic block because of the variety of effects that can be produced from it using identical blocks. The log cabin block is composed of sixteen rectangles and a center square. Pairs of adjacent rectangles form L-shapes as shown in Figure 1. The completed computer program, although attractive, useful, and easy to operate worked only in a specialized environment.[1] During the years that followed, I longed for access to that program. I dreamed of finding time to adapt the program to the PC environment. Eventually John Kautz, my colleague and office-mate at The American University where we were both on the faculty, became interested in the project. John wrote the program in Turbo Pascal, working initially from my functional description and from slides showing the original program in action. The end result is a computer program called *Log Cabin Quilt Designer* for which we received a copyright in Fall 1991 whose educational and other uses are described in this paper.

This paper is divided into four sections. The first section describes in detail, for the non-quilter, what a computer program can do for a quilter. The second describes the capabilities of the program. The third section describes how the program can be used as a tool in a basic design course. The fourth and final section briefly describes other class environments in which the program can be used. It is our hope that some of you who read this paper will want to use the program in your classes either directly or as an example of the possibilities for integrating the needs of those in disciplines outside of computer science with the capabilities of those in computer science.[2]

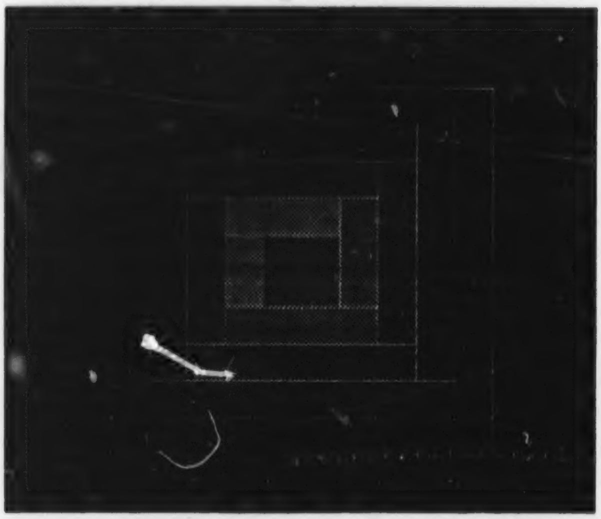

Figure 1. Log Cabin Block

What Can a Computer Program Do for a Quilter?

A problem confronting a quilter, or anyone else working with blocks of color, is to realistically predict how an image will appear when the colors are combined. Pieces of fabric, each of which is attractive, all of which appear to 'go' well together, take on a character of their own when cut and placed together in a fixed pattern. The colors appear to change before the eyes of the beholder. The interposition of lights and darks, of shades of a particular color, of complementary colors, all create very different impressions according to the placement of the colored pieces.

Untold hours of work go into the creation of a pieced quilt. The fabrics must be selected, purchased, washed, cut and then sewn together. Their placement in relation to one another must be determined in advance. After the pieces are sewn together to form blocks, the blocks must then be oriented in relation to one another and sewn together to form the quilt top. The work described thus far completes all of the quilt top except the border. The quilt top, batting and quilt backing are then anchored together and the actual work of quilting begins. The quilting consists of tiny running stitches which cover the quilt in a pattern and to a degree chosen by the quilter. The reason for this somewhat elaborate description is to suggest to the reader the difficulty of selecting the colors and fabrics to put together to form the original block. If a 'mistake' is made, its correction is, at the least, agonizingly time consuming and at the worst, impossible. This contributes to the intimidating nature of the color and fabric selection. The traditional ways of reaching the decisions about color and block placement involved cutting out fabric pieces and sewing them together to construct a sample block or making colored drawings of a variety of sample blocks until the 'ideal' one was found. After all the quilt blocks were completed, the quilter would lay them out on the floor and move them around until the most satisfactory all-over pattern was selected. A problem with this phase of the quilt design is that laying the pieces out is time-consuming and there is no easy way of recording a layout so that it can be replicated. Nor is there a way to quickly compare two alternate layouts.

The author's desire to construct a quilt using the Log Cabin block, a traditional pattern, and the problems alluded to above led to the creation of the *Log Cabin Quilt Designer* computer program. This program allows the user to perform a computer simulation of the traditional process thus avoiding the physical experimentation previously necessary. Quilt blocks and quilt tops created using the program can be saved for subsequent retrieval. Thus color choices *and* block layout can be definitively decided upon before any fabric is purchased or sewing is done. The screen can be photographed enabling away-from-the-computer comparisons of alternate quilt tops. Once the final decision is made the photographs can be taken to the store to help in fabric selection.

How Does the Program Aid the Quilt Designer?

The program is designed to allow the quilter to experiment with different palettes and with different placements of colors from the palette as pieces of the Log Cabin block until satisfactory results are achieved. Those palettes and placements the quilter finds agreeable may be saved for later review. Once a pleasurable block has been formed the user may push a key to see an entire quilt top with the block replicated sixteen times. While the quilt top is on the screen, the user may rotate any or all of the individual blocks to vary the appearance of the quilt. The user may also view the quilt top without the lines outlining the individual component pieces of each block. On the computer screen, the quilt top without the outlines produces a significantly more brilliant appearance than the one with the outlines.

The program has three screens: one which allows experimentation with the colors in an individual log cabin quilt block which is called the initial screen in the description that follows [Figure 2]; and a second and a third screen, referred to as alternate screens, which show a quilt top consisting of sixteen identical replicated log cabin blocks [Figures 3 and 4]. These latter two screens are identical except that the lines separating the block and those indicating the individual pieces of each block are not shown. The purpose of these latter two screens is to allow the user to experiment with the orientation of individual blocks within the quilt top in order to see different layouts and determine which is the most desirable. The user has the ability to move back and forth between these screens at will and to save pleasing color and orientation patterns for later recall.

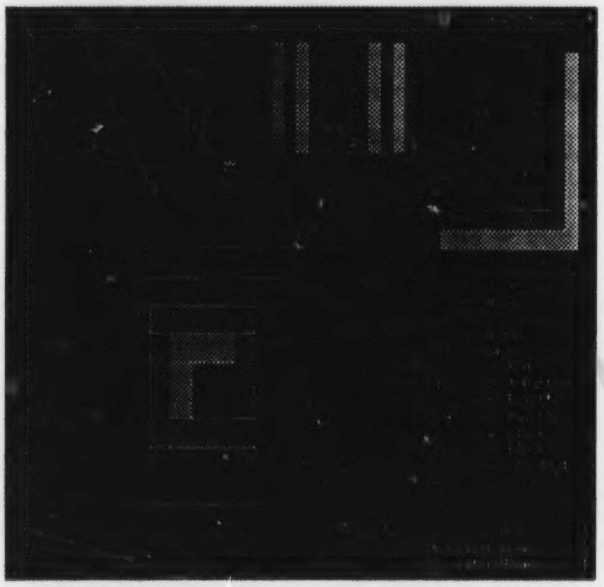

Figure 2. Initial Screen

The initial screen, shown in Figure 2, is divided into four windows. The leftmost and largest contains a palette of 16 colors and a large single Log Cabin block. The palette colors at either end are permanently set, one at black, the other at white. Each of the other colors can be modified by the user by pressing keys which alter the amounts of red, green and blue in the color.

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To enable the user to distinguish between non-adjacent colors in the palette which look alike but may be slightly different, the amount of red, blue and green in each of the palette shades is shown as a number between 0 and 3 when the cursor is placed beneath the color. Up to ten different palettes can be saved for later retrieval.

The large Log Cabin block initially appears all in gray. This is the block in which the user's color selections will be shown. Up to ten different block arrangements using a given palette can be saved for later retrieval. The right-hand third of the initial screen is divided into three windows. The top right window is the smallest window and its function is to tell the quilter which of the stored palettes and blocks are currently on view in the large Log Cabin block. The middle right window is a small single Log Cabin block with one of the pieces highlighted. It is used to select the piece of the large block whose color is to be altered. The bottom right window contains a 'menu' of actions available to the user. This initial screen is used to experiment with the colors of an individual block. Pleasing blocks can be saved. Previously saved blocks can be retrieved.

The alternate screens are each divided into three windows. The first shows the sixteen blocks of the quilt top all similarly aligned. The second shows a block of sixteen squares, one white, all the others black which are used to indicate which block is to be rotated. The third presents a menu of alternative actions to choose from. On the quilt top any or all of the individual Log Cabin blocks can be rotated to change the all-over appearance of the quilt. These all-over patterns may also be saved for later examination. As stated previously, the quilt can be seen without the outlines of the individual pieces and blocks by toggling the outline off and on. Figure 3 shows the alternate screen with the outline on and Figure 4, on the next page, shows it with the outline off.

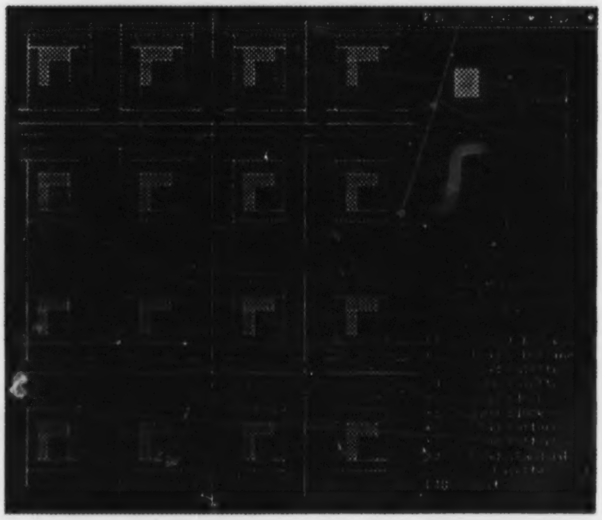

Figure 3. Quilt Top

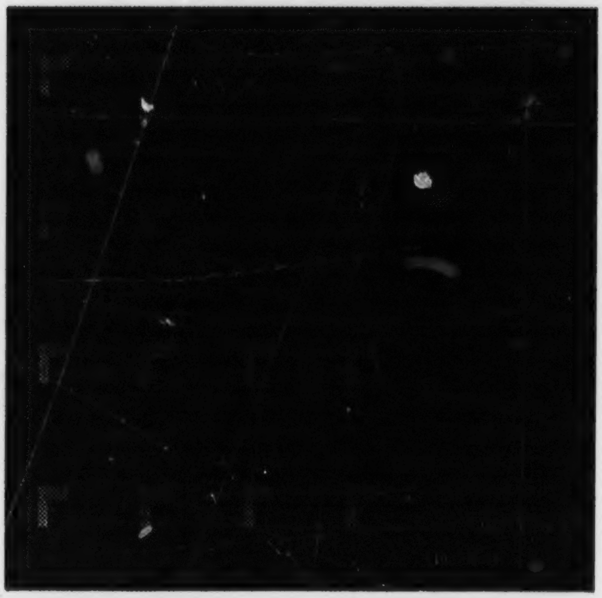

Figure 4. Quilt Top

Designing with a Computer and a Log Cabin Quilt!

A quilter is not only a person who stitches, a quilter is a fabric artist and a designer. Although this program was designed with a particular quilt pattern in mind specifically as an aid to a quilter, it can also serve as an aid to an art or design student, particularly one who will be producing images on a computer in the future.

Artists are traditionally familiar with a color system which is subtractive. In the artist's typical environment, the primary colors are red, blue and yellow. Mixing these colors gives a resulting color which is darker than any of them (Gerritsen, 71).

Thus using equal parts of all three will result in black while using none of them results in white (or the absence of color). Color mixing on the computer is not the same. On the computer, the primary colors are generally red, green and blue, which are the ones used by the quilt program to form other colors. This system is an additive one, in which the resulting color is lighter than any of the components (Gerritsen, 71). On the computer, using three parts of all three will produce white; using zero parts of all three will produce black.

Because the program was designed to allow the quilter to remember how a particular color was formed, one of the program's features provides an indication of the individual amounts of red, green, and blue in each distinct color in the palette. The program demonstrates how each of the basic colors contributes to the resultant color. Thus it can provide direct information to an artist about the underlying color structure of a drawing to be done on a computer. Artists can obtain a good understanding of how this works by forming colors consisting of from zero to three parts of any or all of the colors red, blue, or green. The quilter/artist is able to play with the colors in an

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existing palette, to alter them, before and/or after choosing where in the block to place them.

In her book, *Color for Quilters*, Susan McKelvey discusses a variety of topics relating to color such as: harmony, contrast, transparency, background and foreground, and the symbolism of color. For each of these topics, she suggests projects to help the quilter understand how she can use color effectively. The exercises which are performed with fixed shapes and/or colors using paint and/or paper cutouts in traditional basic design classes for the purpose of creating different patterns, effects and moods can be carried out by simply by pushing keys on the computer.

The different effects caused by the juxtaposition of lights and darks can be experimented with as can the way placing two colors next to each other effects each of them. The ability to create a large variety of patterning effects with the same basic element, in this case the Log Cabin block, facilitates understanding of these effects. Only by experimentation is it possible to comprehend the multiplicity of effects that can be achieved by rotating any or all of the identical blocks in a quilt top. The effect of rotating individual blocks on the quilt top different amounts is shown as Figure 5.

By repeating the same color in different places in the Log Cabin block (initial screen) one can obtain quilt tops (alternate screens) which do not appear to be log cabin designs. This effect can be seen in Figure 6. The effect of removing the outlines from the individual pieces and the block is shown in Figure 7. Some people claim to see a primitive bird in Figures 6 and 7.

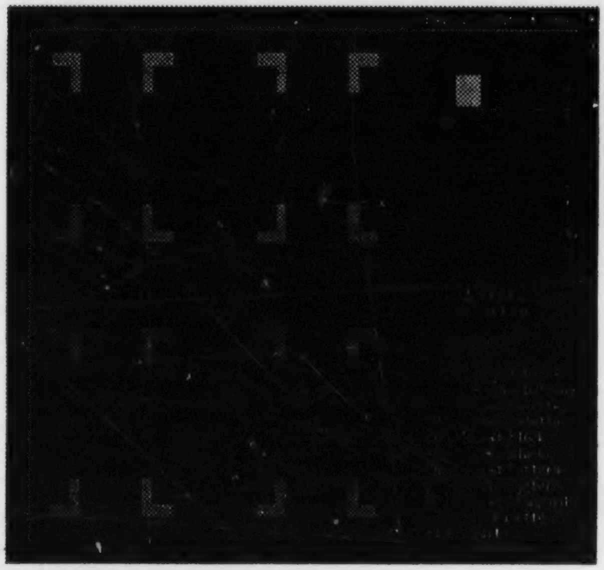

Figure 5. Rotating Blocks

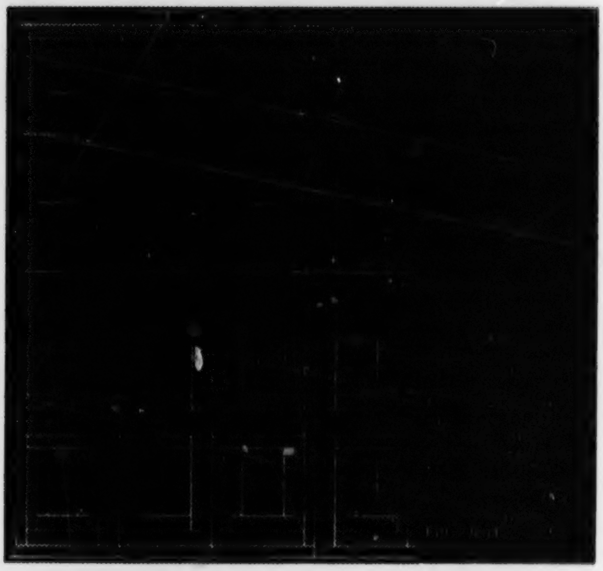

Figure 6. Log Cabin Quilt?

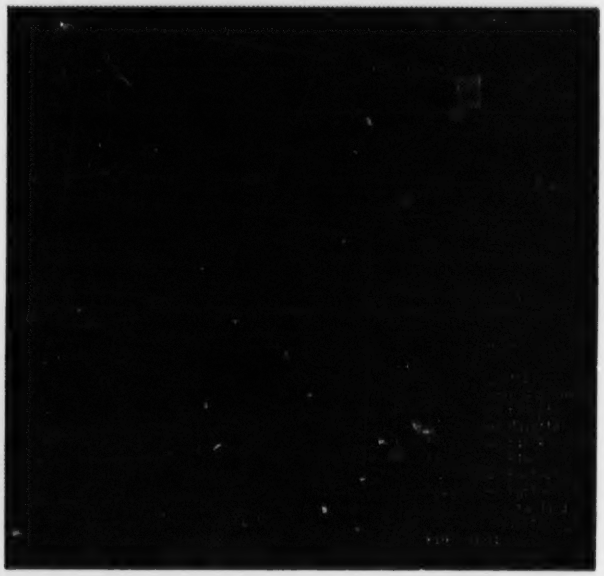

Figure 7. Log Cabin Quilt?

Using the Log Cabin Quilt Designer In an Educational Setting

The applications suggested here can be divided into two basic categories: those which involve using the program as it exists (quilting, psychology, color theory or basic design applications); and those which involve altering the existing program or creating similar programs (computer science applications). Some are interdisciplinary. Others are not.

There is a new group of artists who work closely with programmers designing screens for various purposes which the programmers then implement. Among these purposes are: teaching new computer users how to use a particular system and creating tantalizing images which enchant children and adults

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into playing games. Analyzing the layout of the screen and the effectiveness of the quilt program, as it guides the quilter in its use, can be a useful learning tool for students in this area of design. Those entering this field also need to explore the interaction between humans and computers. When John Kautz and I realized how much time we had spent discussing and redoing the user interface for this program we realized that this program can provide the basis for an excellent interdisciplinary project for computer science students in a human factors course and those in a design course. The source code for a preliminary version of the program can be modified by teams of student designers and programmers who work together to improve the user interface. Such students might end up with quite a different interface than we did.

Students in a design course can run experiments using the existing program to determine: which colors observers find most atractive; which parts of the screen catch the users' attention; whether the eye is attracted by color, shape, pattern or size. The exercises suggested by Susan McKelvey to help quilters use color effectively are similar to those used by students in a basic design course and these exercises can be done on the computer using this program. The restricted shapes present in the Log Cabin block provide an additional constraint but such constraints are often imposed in design projects.

Students in a computer graphics course, using what they see on the screen in this program can construct a program to produce patterns other than the log cabin to be used as the basic block. Alternatively they can work from source code. The source code for this version or the program consists of about 1000 lines of uncommented Turbo Pascal code. An earlier version of the program available for use by teams in a software engineering course as a maintenance exercise.

Color theory teaches that when colors are used together, the effects that are created are somewhat predictable. A monochromatic color scheme will give a harmonious effect. Combining pure hues will give a vibrant effect. Yellow dominates. Separating colors with white makes the colors appear stronger. Adding gray softens and neutralizes. Those computer science students who will build commercial software products in the future can benefit by learning about these color characteristics. So can students in the commercial art field who will use computers as the canvas on which they construct their images.

Psychology students can store Log Cabin blocks and quilt tops and use them to to measure user reactions to various color combinations and patterns. It was even suggested, by an Australian colleague, that the program can be used to test spatial perception by asking students to describe the difference between two successive quilt tops using the same basic block where the blocks are oriented differently. Another colleague suggested that the inability to determine how to transform one quilt top into another, where the only difference is in the rotation of the various blocks, might be a sign of brain dysfunction. Using the program in this way could provide an interesting psychology project.

Students in a math class can be asked to estimate and then compute the number of distinct: palettes, quilt blocks, or quilt tops that can be created using the program and thus gain an improved understanding of permutations and combinations.

Elementary school children can play with color and construct pleasing blocks and quilt tops as they do when they select colored tiles to fit into a fixed frame. Teachers can prepare exercises in which students are told, as on Sesame Steet, that 'one of the blocks is not like the others' and asked to find and rotate that block until all the blocks are aligned. Students can also develop their spatial perception awareness by being shown a quilt top on the teacher's computer in which some of the blocks have been rotated and by being asked to duplicate the pattern on their computers.

Summary

This paper has described a program designed to aid a quilter wanting to make a Log Cabin quilt. It also suggests a number of potential uses in an a variety of educational environments. The program, written in Turbo Pascal, requires an EGA or VGA monitor and associated graphics card to run. It takes significantly less than 256K of memory. It can easily be used by a novice computer user and has been presented to illustrate how a computer program can be a tool for use in a non-traditional area; how a tool designed for use by a fabric artist can be used by an art student studying design; and how a piece of software designed for a particular purpose can be a useful component in a number of distinct courses within the computer science curriculum.

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[1] It ran on a VAX using George Washington University's Core Graphics.

[2] The program is available at no cost for use at educational institutions. Contact the author at the Department of Mathematics and Computer Science at Hood College in Frederick, Maryland 21701.

Paper (W1-06)
Computing with Both Sides of the Brain

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Abstract

Over the past five years computer instruction for non-computer majors has moved from programming language instruction to instruction in the use of spreadsheet and database packages. However, students progressing past the most elementary spreadsheet and database applications still must master basic algorithmic concepts. We have found that the spreadsheet/database environment is not necessarily the best environment for learning these concepts.

We have used QuickBASIC graphics in a Logo-like fashion to introduce students to the algorithmic techniques they need in order to produce realistic business applications using spreadsheet and database packages. Previous experience with Logo has convinced us of the value of using graphics to introduce students to the computer environment. The benefits of learning in a graphics environment have not been generally exploited in teaching more traditional languages and are missed totally by students who begin their computer experience learning to "program" using spreadsheet and database packages. The use of graphics allows students to "enter" the screen and participate in a kinesthetic manner as they produce graphic images, thereby exercising the right (image processing) part of the brain as well as the left (symbol processing) side. The result is that students learn faster, retain more, and thoroughly enjoy the experience. By introducing students to algorithmic techniques in a course built around the graphics capabilities of QuickBASIC we have found that students who have been "turned off" by traditional programming/spreadsheet/database instruction become enthused, learn the concepts, retain them, and are able to transfer them to other domains.

Introduction

This paper relates our experience using QuickBASIC graphics to teach algorithmic techniques, examines the environment which makes this approach feasible, discusses our use of QuickBASIC as opposed to Logo, and concludes with a couple of general principles which this project has brought to light. In the accompanying talk we will discuss some of the techniques we use in the course and will present examples of student work which illustrate the effectiveness of the approach.

As faculty in the School of Business in a small liberal arts college, our goal is to enable students to use the computer as a productive tool in their studies and careers. Specific objectives are to see that students understand enough hardware and software concepts to be informed consumers and users and to ensure that they are proficient in using the operating system, spreadsheets and database packages. Word processing is taught elsewhere in the college. Toward this end we have developed two courses: the first aimed at familiarizing students with the computer (MS-DOS, terminology, hardware, and basic algorithmic techniques). The second course covers spreadsheet and database packages where students produce realistic business applications which require spreadsheet macros and database procedures or scripts. Spreadsheet macros and database procedures both employ standard algorithmic techniques (loops, selection, and functions). We have found that students are better able to grasp these algorithmic techniques by using QuickBASIC graphics in a Logo-like environment than in a textually oriented spreadsheet or database environment.

The importance of engaging both sides of the brain is well accepted within the research and educational community. In describing the biological connection Baron [Baron 87] notes that "... the verbal description of an event, which would be stored on the left side of the brain, automatically elicits recall of the sensory (affect, visual, auditory) representation of the same event, which would be stored on the right side, and vice versa." Alan Kay in a recent presentation [Kay 91] discussed the "Imaging Revolution in Learning" and the advantages of "...direct communication to more than just the symbolic parts of the brain..." He tied the concept to work by:

- Minsky... You don't understand something if you only understand it in one way
- Bruner... for any type of instruction there is a mentality that is best suited to receive it
- and Caloway... the part of the mind that you want to learn doesn't understand English.

Jane Healy , author of *Endangered Minds*, argues that our educational system must recognize the visual world that today's student is a product of. In describing the Visual Mathematics Library Ralph Abraham writes:

> The absence of visual representations in the curriculum may be part of the problem, contributing to mathematical illiteracy, and to the math-avoidance reflex. ... mathematical concepts may be communicated easily in a format which combines visual, verbal and symbolic representations in tight coordination. It aims to attack ignorance with an abundance of visual representations.

In a manner similar to that described by Abraham, our Introduction to Computers course has become a problem solving environment in which the graphics are both the problem... and a visual check on progress toward a solution. Graphics, mathematics, algorithmic thought and verbalization are tightly coupled in a way that excites the mind and provides the less mathematical student a learning environment that promotes their success.

While the concept of using graphics to engage both sides of the brain is not new, it has not been widely applied. Until recently, an instructional computing environment capable of supporting this paradigm was not generally available. Prior to the mid '80s classroom computing instruction was aimed primarily at training computer programmers. Instructional hardware was expensive and scarce. It was generally provided in a lab setting or was distributed as one or two stations per classroom. Instruction was therefore based primarily on blackboard techniques. Graphics capabilities were almost non-existent on mainframe or mini computer facilities typical of college environments and were limited on the personal computers available at the time.

Logo stood out in this environment in three regards. First, it is aimed at general cognitive development as well as programmer training. It provides an environment in which students at any level can play with problems in physics, geometry, computer science, artificial intelligence or any other discipline. They can experiment and try out possible solutions. Second, it requires an interactive environment. Since the goal of Logo is to use Logo to explore other domains, it makes no more sense to simulate Logo on a blackboard than it does to simulate a microscope or centrifuge. The third innovation in Logo is its extensive use of graphics. The Logo turtle gives students a visual reference for their experiments. They can see the results of their experiments as images rather than simply as numbers and symbols. The use of graphics is also a powerful attractor. It gives the student the power of creation. They sit mesmerized as the image they have created unfolds before them. They are often surprised and led to ponder and analyze when the image is not what they expected. They experiment and refine until it meets their expectations only to start anew as each creation suggests new ideas, new methods, and new creations. Graphics are the soul of Logo.

Today's instructional computing environment has, in some areas, caught up with Logo. The main thrust of computer instruction is now to train students in the use of computer tools such as spreadsheets, database packages, image and word processors. Hypermedia offers the promise of providing interactive learning environments in almost any subject area. The availability of low cost personal computers has made it feasible to teach in a hands on-computing environment. Computer classrooms now complement computer labs in schools and colleges. Students no longer have to wait until they go to the computer lab to try out what they have learned. In a computer equipped classroom, lecture, practice, experimentation, and active learning can take place simultaneously. In addition, significant graphics capabilities are available almost universally on personal computers. Instructors now have the potential to involve the visual as well as the symbolic side of the brain in the learning process.

Yet, today's typical instructional computing environment is far from the graphics environment provided by Logo. Interest in Logo has declined, replaced largely by interest in practical tools (spreadsheets, database packages, image and word processing packages) on the one hand and hypermedia environments on the other. On the tool side, graphics are generally relegated to producing graphs and charts from spreadsheets and databases or drawings using illustration packages. While these are useful skills, none of these activities exploit the ability of graphics to illuminate the thought process as do Logo graphics. Missing is the graphics environment which enables a student to visualize the process through which his/her results are obtained. The graphics in a spreadsheet or database package may help a student understand a trend in the data but offer no clues as to why a macro, script or procedure does not work. The student who is introduced to the computing environment via spreadsheet and database packages must learn the algorithmic techniques they need much as a blind man learns of his environment... without the graphic clues which our brains have come to rely on. Producing a spreadsheet to analyze alternative payment or investment scenarios is useful but it cannot compare to the task of creating a butterfly and making it flutter about the screen in terms of holding a students enthusiastic attention.

Hypermedia holds greater potential than the spreadsheet or database areas in terms of providing a graphics environment. A student creating a hypermedia script can experience a Logo-like environment but, all too often, hypermedia comes pre-packaged. Someone else has already created the environment. While packaged hypermedia productions often offer spectacular graphics, they generally offer a fixed environment for the student to explore. They offer little opportunity for the student to create.

Recognizing that students starting their computer experience with spreadsheet and database packages were largely probing in the darkness, we have elected to provide a Logo-like graphics environment in which they can work. In this graphics environment students not only learn the algorithmic techniques they will need, but also emerge with a sense of mastery, a feeling of enthusiasm, and an eager desire to do more with the computer. They can then proceed to use those techniques in a spreadsheet or database environment to solve realistic business problems.

Having built a case for Logo-like environments, you may well be asking why we use QuickBASIC to create a Logo-like environment when we could use Logo and have the real thing. Regardless of what your local Logo enthusiast tells you, the real answer is that it is the environment, not the language that is important. Pappert did not just create a language… he discovered a paradigm for teaching, the language is incidental.

In the early days of Logo it just happens that Logo was about the only language available which provided a Logo-like environment. BASIC, at that stage, was simply a language designed to train FORTRAN and COBOL programmers. Much has happened to BASIC since then. QuickBASIC today has more resemblance to Logo than it does to the early versions of BASIC, and no longer possesses any of the drawbacks [Harper 89] which previously made Logo far superior. Friendly [Friendly 88] notes that "the power of a language does not come from what you can do with it… Rather the power of a computer language is related to what you can think with it." If your goal is to think about micro-worlds, language processing, or knowledge representation then Logo is clearly superior. As our goal is to think about algorithmic techniques applicable to spreadsheets and database procedures QuickBASIC is quite sufficient.

In our setting QuickBASIC has three advantages over our version (LCSI) of Logo. The first relates to the use of iterative as opposed to recursive techniques. We are dealing with the development of iterative concepts. While recursion is a powerful and interesting concept, it is of little use to spreadsheet and database users. The mechanisms for iteration are somewhat less cumbersome, clearer, and more forgiving in QuickBASIC than they are in Logo, particularly where explicit counting is involved. Compare QuickBASIC's

```
Count = Count + 1
```

with Logo's

```
MAKE "Count :Count + 1
```

Spacing is not critical in the QuickBASIC version but is critical in the LCSI Logo version.

The second two relate to the ability of the language to interact with modern computer hardware. As an active product QuickBASIC has accrued an advantage over Logo in terms of its ability to interact with modern hardware. QuickBASIC has better graphics. While LCSI Logo is still using CGA graphics (320 x 200 resolution with 4 colors) QuickBASIC has been upgraded to VGA graphics (640 x 480 with 16 colors). As it is the aesthetics of the image that create much of the enthusiasm in a Logo environment, we feel that this again is an advantage. In addition LSCI Logo cannot print Logo procedures or graphics on an HP Laserjet printer… and that's all we have.

Could we do the same thing with Logo? Yes. Again, it is the environment that is important, not the language. Are we advocating that QuickBASIC should replace Logo? Absolutely not, we still use Logo to introduce students to recursion prior to teaching Prolog. Prolog requires an understanding of recursion. In a previous study [Cutting 90] we have found that the Logo environment is so superior to the Prolog environment for introducing students to recursion, that students can learn Logo and Prolog in less time than Prolog alone.

Results

While the results of teaching algorithmic techniques in a graphics environment rather than a spreadsheet or database environment are not as definitive as those we obtained by teaching Logo before Prolog, there are clear advantages. In terms of enthusiasm and attitude, it is immediately obvious to anyone who has taught in such an environment that students love learning in a graphics environment. It is not uncommon to have to "kick the class out" at the end of a period. When the room is not scheduled the following period at least part of the class will often stay to continue working on a problem after the teacher has left. In terms of efficiency, we cannot say at this point that one can teach QuickBASIC, a spreadsheet, and a database in less time than one can teach a spreadsheet and a database alone. One reason is that algorithmic techniques play a smaller role in the use of spreadsheets and databases than recursion does in Prolog, hence the effect is not as pronounced. In terms of effectiveness it is clear that students who have not been exposed to algorithmic techniques prior to encountering them in a spreadsheet macro or database procedure tend to stumble at that point. Many become frustrated and discouraged. On the other hand, students who have learned algorithmic techniques in a graphics environment tend to react as if they have found an old friend. They see a new way to apply a familiar technique to add greater power and flexibility to the tool they are now learning.

General Lessons

In addition to suggesting a better way to teach spreadsheet and database packages this project has brought to light two general principles. The first is a version of "study history or repeat it", "don't reinvent the wheel", etc. In contrast to most fields of endeavor, the computer field is evolving at a rapid, often confusing pace. In our efforts to adapt instruction to the frequent changes in this field it is particularly easy to forget the lessons of the past and abandon the techniques which in slower moving fields would have received more thorough exploration. While Logo still has a loyal following it has, to a large extent, faded from the spotlight and much of what we learned from it has not been transferred to subsequent environments. Real progress in any field requires that the lessons of the past be carried forward. We need to periodically clear away the hype and evaluate what we are doing in terms of what has worked in the past.

The second principle is that the environment in which a student will ultimately use a skill is not necessarily the best one in which to teach the skill. It may pay to select or create an environment which is more conducive to acquiring the skill. There is a similar economic principle known as the principle of roundabout production. Basically it states that the most direct method of producing something is not always the most efficient... it is often more efficient to take the time to develop tools to produce goods than it is to immediately start producing goods without tools. A graphics environment is a good tool for learning the algorithmic techniques required for advanced spreadsheet and database use.

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Paper (W1-06)
Using Artificial Intelligence Concepts to Teach Problem Solving

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Abstract

Although a century ago the psychologist James [3] suggested that humans are not designed for abstract thinking, in 1952 Piaget [4] promoted the belief that people begin to reason abstractly at about the age of eleven. It has been accepted by educators in the elementary and secondary domain that "hands on" enhances learning, particularly in mathematics and science. We believe that students need "minds on" activities to promote learning and improve abstract thinking. "Minds on" in this context means the opportunity to solve problems in a structured environment. We support Polya's statement [5]: "Solving problems is a practical art like swimming or skiing or playing the piano; you can learn it only by imitation and practice."

*We as computer science educators should make use of "minds on" activity in **all** of our computer science courses. A common complaint heard among educators at the university level is that students don't know how to write programs. While they seem to know the syntax of the language and have a reasonable grasp of the semantics of the language, they will freely admit that 'they don't know how to get started'. "Minds on" activities in classes or labs force students to see "answers" after they have had an opportunity to think about the problems. Most students, when they read textbooks, do not: 1) see a new problem; 2) put the book down while they think; and then 3) solve the problem themselves, i.e. create a computer program. Most students see the problem, keep reading and sooner or later see a solution. Even if the logic behind the program is discussed in the text or in class, it is still presented 'after the fact'. While one could argue that programming exercises outside of class should give students that opportunity, the results seem to indicate that feedback usually is not given in a timely manner to encourage problem solving skills.*

Introduction

We suggest a "minds on" environment in which the students are presented with application problems and are asked to use techniques discussed in lectures to represent or represent/solve the application problems. This environment operates under two objectives: 1) that problems often can be solved in more than one way; and 2) the thinking used to create the solution is often more significant than the solution itself. The students work in small groups of 2-4 students using specific questions on a handout to guide their thinking. The course instructor monitors the discussions and offers subtle suggestions when appropriate. Because of time constraints, not all groups may arrive at a solution. At the end of the given time, the student's solutions are elicited through a general discussion. Because the instructor has monitored the discussion, the most promising solutions can be elicited first (last); however, all students are given the opportunity to share their strategies. Students are guaranteed to see at least one strategy from the instructor. No grade evaluation of the student's work is made at this time. [Students are given similar problems to solve during regularly scheduled exams.]

We have followed this "minds on" philosophy in an introductory graduate course on Artificial Intelligence (AI), i.e. the emulation of human thinking by computers! The problems which the students attempt are 'simple' problems often presented in AI textbooks. The simple problems are taken from commonly studied areas such as robotics, planning, game playing, vision, puzzles which involve moving tiles or other objects, and natural language processing.

Because of the diversity of areas of AI study we let the representation and manipulation of knowledge through the "problem solving process" be the unifying theme for our introductory course. Because human reasoning eventually formulates the computer system that is to become the "artificial thinker", it is important that students become attuned to the way that they approach the problem solving process. This approach must incorporate logic and organization.

We have four major objectives: to learn how to represent problems according to the paradigms of AI research; to learn standard search techniques which can be applied to the models in order to obtain solutions; to become familiar with the various subfields of AI; and to appreciate how students and programs can be "made" to learn.

Representation of Problems

One of the hardest tasks facing students in AI, as well as in all computer science courses, is coming to an understanding of the "essence" of a problem. The "essence" of a problem is that collection of attributes which must be present in the representation and which serve to direct the solution process. AI has three traditional representation models. A state space representations is based on the many "states" (collective values of important attributes) which can arise during manipulation of the problem. A problem reduction representation views the problem as a reduction into subparts. A rule-based representations concentrates on moving between states or problem subparts. Each of these representations requires that students focus on the significant attributes of the particular problem at hand and map these attributes into the appropriate model. We have two goals: to help students appreciate the difference between the models; and to identify the attributes of a particular problem which are to be expressed in the model.

As an example, consider the Tower of Hanoi Problem. There are n disks $D_1, D_2, ..., D_n$, of graduated sizes and three pegs A, B, and C. Initially all the disks are stacked, by increasing size, on peg A, with D_1, the smallest, on top and D_n, the largest, at the bottom. The problem is to move the entire set of disks to peg C given that only one disk can be moved at a time and that no disk may be placed on top of a smaller one. The answer to the question "What are the Tower of Hanoi problem's essential features?" easily allows the creation of two state space representations and one problem reduction representation. One can focus on the pegs, monitoring which disks are currently on a given peg (cf. Figure 1). One can focus on the disks, recording for each disk its current peg location (cf. Figure 2). Or one can focus on the problem, trying to express it in terms of a sequence of subproblems (cf. Figure 4). In Figures 1 and 2 we show three representative states of the given state space representation dictated by our focus. In Figure 3 we show an entire state space for the Tower of Hanoi problem limited to three disks using the focus and notation illustrated in Figure 2.

We use "minds on" skills to try to create more than one representation for each problem (by creating two different instances of state space representations or by creating a state space representation and a problem reduction representation). We encourage their search by asking questions which shift their thinking among the various attributes which will "drive" a given representation.

Standard Search Techniques

Since there are a large number of problems in AI which are not solvable by direct means, we study a variety of search techniques. These include those which are uninformed, i.e. those that behave according to rules which are both independent of the particular problem and independent of the current state of knowledge; and those which are informed, i.e. those techniques whose current behavior is based on the current knowledge about the solution of a particular problem. For example, the uninformed search techniques which are discussed include depth first search, bounded depth first search, breadth first search and the uniform cost strategy. Informed search strategies include the irrevocable control strategy of hill climbing, general best-first strategies, and A* and AO* strategies (which are special instances of best-first).

Initial state: ((D_1, D_2,..., D_{n-1}, D_n), Δ, Δ)
An Intermediate state: ((D_4, D_5, ..., D_{n1}, D_n) , (D_1, D_2), (D_3))
Final state: (Δ, Δ, (D_1, D_2,..., D_{n-1}, D_n))

Each state is denoted by a 3-tuple where the entries in the 3-tuple represent the three pegs A, B, and C, respectively. The representation for each peg is either an ordered list or a stack, top of the peg downward.

Figure 1. State Space Representation for Tower of Hanoi: Focus on pegs for an n disk problem

Initial State: (A, A, A, ..., A)
An Intermediate State: (B, B, C, A ..., A)
Final State: (C, C, C, ..., C)

Each state is denoted by an n-tuple where the i-th entry records the peg on which the i-th disk currently resides. The first entry would represent the smallest disk, the second the next smallest, etc.

Figure 2. State Space Representation for Tower of Hanoi: Focus on disks for an n disk problem

We use the "minds on" strategy to encourage students to recognize what are the underlying circumstances of a given problem which suggest a particular search technique. Although students are initially familiar with some of the simpler search techniques, depth first search and breadth first search, they usually have not had to make a decision about which technique to use. With questions we guide the students into considering which techniques 1) will guarantee a solution; 2) achieve a solution fastest; and 3) explore the fewest partial solutions. For example, using the state space representation in Figure 3 for the Tower of Hanoi, and assuming that the "next" states were generated as they appear left-to-right in that figure, the search would reach the state (B,B,B) during exploration. This is true whether or not the search being made is depth first, bounded depth first or breadth first. However, what differs is how many states have been generated and explored over the search to that point. [Breadth first search will have generated and explored all of the states which lie above (B,B,B) on the page whereas depth first search will have generated only those states which lie in the "left half" of the figure along with the state (C,A,A)]. The small group discussions allow students the opportunity to become acquainted with and focus on several viewpoints.

The informed search techniques often rely on the development of heuristic functions to guide the search. Heuristic functions require a measure of how much progress has been made in the solution , i.e. how much work has already been done, and/or how close the current state is to the final state. Since the creation of an appropriate heuristic function is, in its own right a problem solving process, we use "minds on" direction to help students transfer their "ideas" about what heuristics should drive the search into creating a "formula" which can be evaluated by a computer. For instance, in the Tower of Hanoi problem, they will say that they want to follow the righthand "path" of the large triangle in Figure 4. However, they will have difficulty preventing their heuristic search from arriving at the state (B,B,B). This state has some of the qualities of a solution, i.e., all the disks are on the same peg, peg B. However, the problem statement specifically requires that all the disks finish on peg C.

Familiarity with the Many Subareas of AI

To ensure that students becomes aware of the numerous subfields of AI, we look at some of the simpler problems which arise in each of these subareas and use these as examples in exploring the problem representation- manipulation paradigms.

While many AI educators believe that puzzles should not be an object of study, because puzzles seem to require "insight" rather than technique, we feel differently. We consider the Missionary and Cannibals problem, the Tower of Hanoi (cf. Figure 3) and the liquid pouring problems specifically because their state-space representation can be nicely organized so as to influence the search pattern on the structure. This "organization" is not incumbent upon any clever "insight" to the solution. Moreover, the fact that we can organize the state space representation of such diverse problems suggests that perhaps we should try to do this with all of our problems; not that we will always be successful. We consider cryptarithmetic problems because they are excellent structures on which to apply constraint-satisfaction search techniques. Simple, two-person token games offer excellent examples of the useful strategy of working backward from a solution (end of game). Dudeney [2] has a simple problem of assigning scores on a target to archers which illustrates applying a uniform cost strategy. These problems are all significant because they offer the student the opportunity to understand the representations and the specific techniques without being overwhelmed by the details that would be present in a "real-world" problem. This is certainly not to suggest that developing an ability to understand "real-world" problems is not important, for it is. But in this context the objective is to understand representations in a much simplified setting.

To Learn About "Learning"

We use two activities which are dispersed throughout the term, to fulfill the objective to learn about "learning". The first activity involves the study of tactical skill which opponents acquire while playing a two-person strategy game. Students are encouraged to play with any willing opponent (human or computer) subject to the rule that strategy is not discussed (with anyone). Instead of discussion students are encouraged to observe the strategy of their opponent as well as test their own strategy. Their goal is to not only devise a winning strategy but come to an understanding of how they "learned" to win. We have tried this in two different ways: using a game such as Mancala which has no apparent winning strategy; and playing a sequence of variants of Tic-Tac-Toe. With the sequence of Tic-Tac-Toe variants we hope that students will learn how to use knowledge (from previous versions) to gain knowledge about a new version.

The second activity is a study of a series of IQ-like tests. The goal of this activity is to gain an understanding of what form or quantity of knowledge is necessary to gain knowledge. The questions are of a type which are said to measure verbal, visual-spatial and quantitative skills. Different amounts of discussion of answers are supplied in the sequence of the tests. As would seem appropriate, more significant gains in "learning" are made after discussions about why the correct answer is "better" than the other answers.

Conclusion

The students initial frustration with "thinking" is usually followed by a rise in confidence by term's end. The students especially appreciate the immediate feedback since many have spent hours pursing either the "wrong" problem or the wrong strategy. Also they gain an appreciation of the art of stating problems precisely. As an added bonus, many of the working groups persist as partnerships in studying outside class.

Some students are bothered because they are not programming. This complaint is easily countered by remembering that in the software lifecycle of a typical "real-world" programming project, 60% of the actual effort is spent in understanding the problem and designing the solution while only 15% of the effort is spent in implementing the solution.

The techniques and methods used in this AI course can be adapted to any computer science course. Choose small problems which illustrate a specific course objective. Use questions to guide the students thinking so that they develop organization in their "problem solving thinking".

As a final comment we would like to echo the thoughts of Polya. "Our knowledge about any subject consists of information and know-how."; "...[but] know-how is much more important than mere possession of information".

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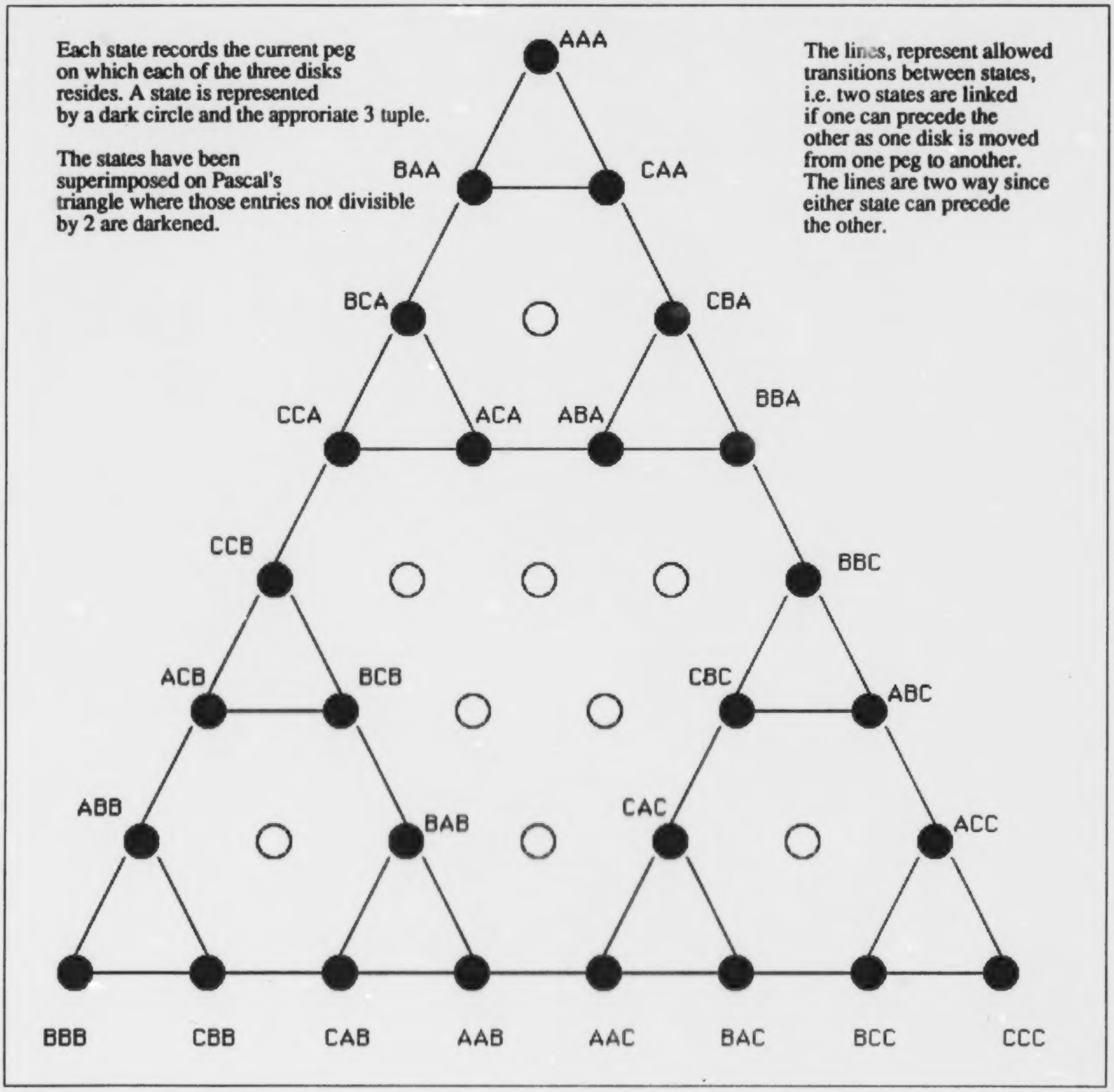
Each state records the current peg on which each of the three disks resides. A state is represented by a dark circle and the approriate 3 tuple.

The states have been superimposed on Pascal's triangle where those entries not divisible by 2 are darkened.

The lines, represent allowed transitions between states, i.e. two states are linked if one can precede the other as one disk is moved from one peg to another. The lines are two way since either state can precede the other.

AAA
BAA
CAA
BCA
CBA
CCA
ACA
ABA
BBA
CCB
BBC
ACB
BCB
CBC
ABC
ABB
BAB
CAC
ACC
BBB
CBB
CAB
AAB
AAC
BAC
BCC
CCC

Figure 3. Complete State Space for Tower of Hanoi: using focus on disks

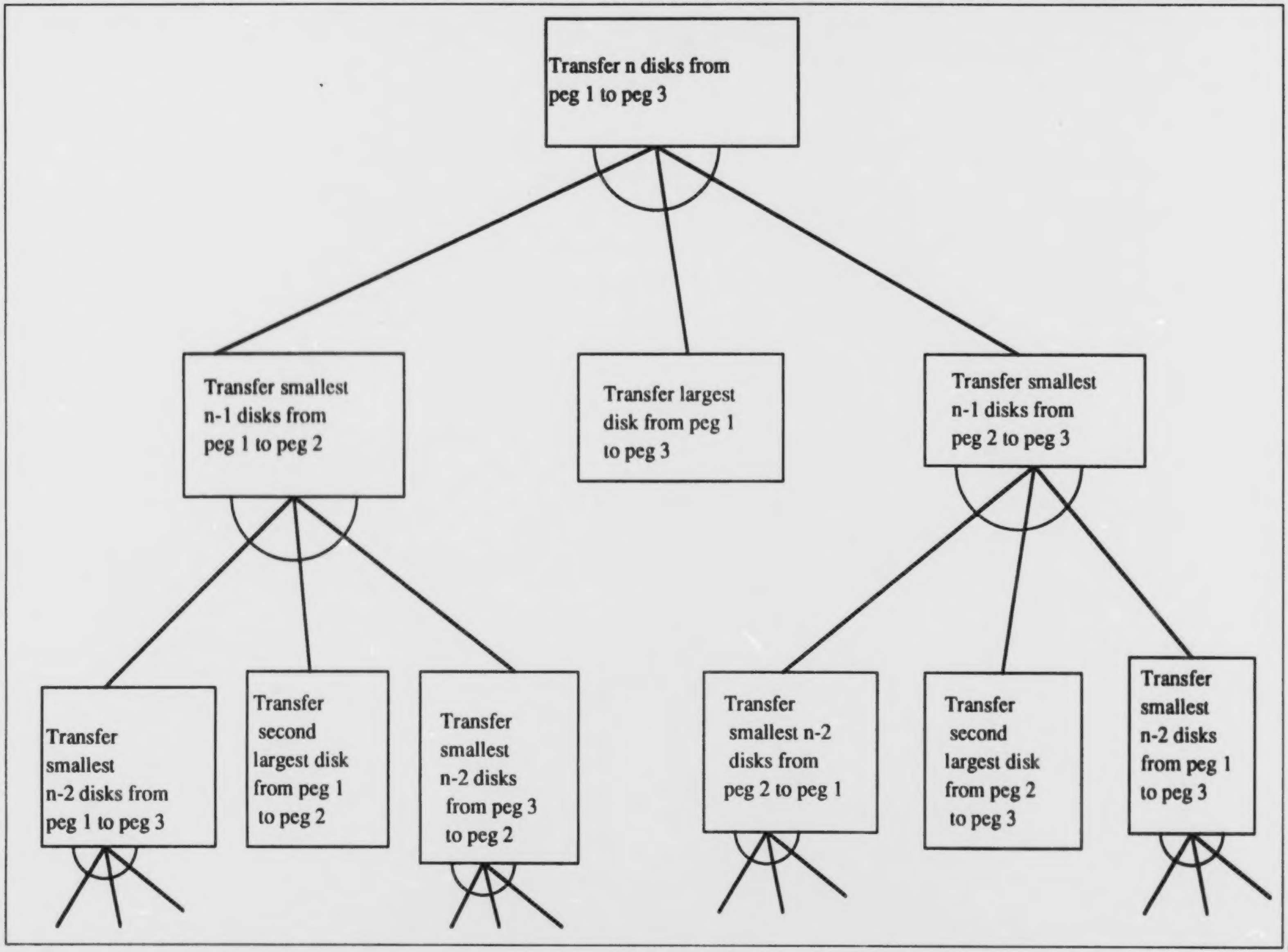
Transfer n disks from peg 1 to peg 3
Transfer smallest n-1 disks from peg 1 to peg 2
Transfer largest disk from peg 1 to peg 3
Transfer smallest n-1 disks from peg 2 to peg 3
Transfer smallest n-2 disks from peg 1 to peg 3
Transfer second largest disk from peg 1 to peg 2
Transfer smallest n-2 disks from peg 3 to peg 2
Transfer smallest n-2 disks from peg 2 to peg 1
Transfer second largest disk from peg 2 to peg 3
Transfer smallest n-2 disks from peg 1 to peg 3

Figure 4. Tower of Hanoi Problem-Reduction Representaion

Projects (W1-07)
Art and Music

Two years of Experiences with Laserdiscs in Three Art Classrooms

Daniel T. Lake
Onondaga/Cortland/Madison Board of Cooperative Educational Services Regional Information Center
Syracuse, New York

Abstract

In 1990, NY State Senator Tarky Lombardi(R) provided a grant to place a complete Art/Humanities Laserdisc Workstation in the hands of each of three K-12 art teachers from three different Central NY school districts. This presentation describes briefly the elements of the Workstation grant (Macintosh SE Computer/Hypercard Stacks/Pioneer 2200 laserdisc player/ TV/ Cart/ barcode reader) and discusses the 7 laserdiscs used then and additions since the original implementation. More importantly, it describes anecdotally the unique uses of the Workstations by the classroom teachers, featuring each art teacher's approaches, successes, and failures. Mr. Lake follows the design of an article published in the March 1992 edition of *The Computing Teacher*, in which he described the teachers' experiences from January 1990 to January 1991. This presentation updates that article with a videotape of the participants discussing how they have integrated the workstations into their lessons since January of 1991.

Inexpensive and Easy Animation to Enhance School Communication

Daniel Ferguson
Santa Fe Indian School
Santa Fe, New Mexico

Abstract

Daily school announcements often aren't well communicated because:

A. students do not listen while waking up in home room
B. students tend not to read notices printed on school letterhead
C. students' memories approach "total-no-recall".

At Santa Fe Indian School, our classrooms are spread among seven or eight buildings with no central intercom to reach all areas. Our school announcements are printed daily, read by the homeroom teacher, and posted in common areas. Using an Apple II GS, Broderbund's *Dazzle Draw*, a video player/recorder and a 21' television monitor, we broadcast our daily announcements in a high traffic area of the campus.Two 10th grade art students create appropriate backgrounds and add text, to create a video "slide". These slides are easily assembled, recorded to video tape and played in a continuous loop on a monitor between the school office and the library.

This animation is effective because:

A. pictures are eye-catching and reinforce the written message
B. when possible, the animation is culturally relevant
C. the whole slideshow can be prepared in a single 50 minute class period
D. we already had most of the hardware and software, our start-up costs were minimal.

This presentation will include a demonstration of the animation and will provide the technical data for other schools to create their own slideshows.

Music, Robotics, Informatics: Integration in Regular Curricula

Paul A. Jansen
National Institute for Curriculum Development
Enschede, The Netherlands

Abstract

Modern technology provides the schools with a lot of possibilities, even beyond imagination. That is not the problem. It is a problem in many countries to find a place in the curriculum of the secondary schools for the subject informatics. Not only as isolated experiments, but a regular place on the nationwide lessontables. Also in the Netherlands. One way to achieve this goal is to integrate the use of information technology into other subjects. The use of wordprocessing in mother tongue is obvious.

In this presentation I will show some results of three projects on integration. One in music, one in technique, both compulsory for all pupils, the third in an educational television program. In technique we developped a lesson sequence for _ 15 lessons in robotics. Traffic lights, a barcodereader, a curvimeter and a buggy, finding its way along a black line are the LEGO models which have to be programmed in LCN-LOGO by the students. In music we develop four sequences in composition, rhythm, musical structure etc. We use computers, keyboards and a soundmodule.

Special attention is given to the didactics, two computer configurations in a classroom is an unusual situation for the teacher. Attention will be given in this presentation to the subject informatics in Dutch secondary education, the mentioned projects as well as some practical demonstrations of the hardware and software.

Encores!

Elizabeth A. Hanson and Sheila K. Kelly
McCarthy Middle School
Chelmsford, Massachusetts

Abstract

Imagine being empowered to have your creativity exceed what you thought were your own limits. Encores! is an interdisciplinary based project that has enabled middle school music students to explore their own boundaries, to problem solve, and to be creative risk takers.

This is and ongoing project developed over the past two years to enhance existing music curriculum using our Apple IIGS lab and standard production programs. Encores! integrates components from creative writing, research, graphics, and music while expanding students' computer skills. This interdisciplinary approach has included such themes as "Emotions," "Ben Franklin," "Funstramentally Your," "Meltdown," etc. While the project has emphasized middle school music, it is flexible enough to adapt to other subject areas, grade levels, and/or levels of technology.

Through experimentation and discovery, each student is provided with opportunities to express his own uniqueness, without regard to academic ability.

Projects (W1-08)
Supercomputing

High-Performance Computing in the High School

Mark Walker
The Ellis School
Pittsburg, Pennsylvania

Abstract

The Pittsburgh Supercomputing Center, with equipment donated by Digital Equipment Corporation, is bringing high performance scientific computing to secondary schools. The aim of the program is to generate enthusiasm and excitement about science and mathematics by enabling secondary school students and teachers to use the capabilities of the world's most powerful computer to explore topics and problems relevant to secondary school curricula. Based on the merits of their proposals, each of ten high schools were given a DECstation 5000/120 workstation linked to the PSC's network and its Cray Y-MP. Students and teachers attended a week-long hands-on workshop prior to the installation of the workstations at their schools; additional hands-on training at the center as well as on-site and e-mail support continued through the year.

This presentation will discuss our school's experience with the program as it is related to our topic of investigation: the formation of rainbows. Emphasis will be placed on the educational objectives of the program, training, scientific and technical support, maintenance of the project, and relevance to secondary school curricula.

Implementation and Evaluation of a University-Wide Computer System

Constance P. Hargrave
Iowa State University
Ames, Iowa

Abstract:

A result of the Supercomputing Access Initiative, Project Vincent is a single distributed computer system modeled after Massachusetts Institute of Technology Project Athena. Project Vincent was undertaken to make a material difference in the computing resources available to Iowa State University (ISU) and to upgrade the ISU campus connectivity to the large and often unique, national supercomputing centers through NSFnet. Over a four year period, Project Vincent is intended to provide ISU with new state-of-the-art computing resources and services. The evaluation of the first year of the implementation of Project Vincent (1990-91 academic year) will be the focus of this presentation. Specifically, the presentation will discuss the implementation of the university-wide project and report the results of the first year evaluation of the implementation of Project Vincent in terms of workstation usage and impact on research, instruction, communication, and culture change at ISU.

Getting Super with Supercomputers

Manorama Talaiver
Lawrence Livermore Laboratory
Berkeley, California

Abstract

The National Energy Research Supercomputer (NERSC) located in Lawrence Livermore Lab trained about 60 high school teachers in the use of supercomputer in August 1991. as a result of this training, the Mathematics and Science Center was able to motivate more than 80 students and 10 teachers to participate in the Superstar project in Richmond, Virginia. The presentation of this project will include the demonstration of movies created by students and a report on gender differences observed during the Superstar project.

The major goal of the project is to get students motivated in he use of technology and get excited about learning mathematics and science. The theme of the project was 3-D visualization (NCTM standards). Participation in this project was not mandatory for the students. They opted to participate in this project. The students were introduced to the software *Wireman* designed by NERSC especially for the supercomputing project. Using *Wireman*, the students visualized animations in three dimensions and createsequence of animations with wire frames (cylinder, sphere, superspheroid, square, cone, and height field). The fly file created in this manner is a text file. The fly file is then sent to the Cray supercomputer via Tymnet. The students give specific instructions to Cray to complete ray tracing and rendering of movies. The movies (binary files) are then downloaded from the Cray as 8 bit or 24 bit binary files and viewed by the software *Movie*. Richmond students have not used two other software available from NERSC this year.

ADAPT Panel (W1-09)

Standards of Excellence: Special Education Best Practice Models

Madalaine Pugliese, Panel Moderator
Marblehead, Massachusetts

Three model programs have been designed to serve students with a wide range of disabilities, and were awarded education grants from Apple Computer, Inc. Guidelines specify that projects would: create an interdisciplinary approach; give students greater control over their educational experience; serve economically disadvantaged students, including targeting the inclusion of special needs students; develop creative and effective uses of technology; and develop linkages between classroom learning and learning outside of school. Now mature projects, the coordinators discuss creating their models, and designing program adaptations, while assessing the changing needs of their target populations. The panel discusses innovative, interdisciplinary technology-based curriculums proven successful and replicable and the efficacy or impact resulting from these dynamic projects.

Communication Exchange and Desktop Publishing with Adaptive Access

Bonnie Paulino
Kennedy Day School
Boston, Massachusetts

Abstract

Students in the Kennedy Day School at Franciscan Children's Hospital in Boston are using a Macintosh computer network to develop skills in writing and graphic arts, showcased in a school newspaper and creative writing journal; work has also begun on a news show for simulcast to patient rooms and waiting areas. Students, with a range of severe and multiple physical, cognitive, emotional and communication challenges and special health needs, utilize computer tools to enhance interaction, outreach efforts, independence and self-directed learning endeavors, through use of adaptive access, online services and inter-classroom/hospital residence communication.

Creative Writing and Self Expression for At-Risk Residential Students

Theodore Phillips
Waterford Country School
Quaker Hill, Connecticut

Abstract

With the help of a three-year Crossroads Education Grant from Apple Computer, Inc., Waterford Country School is providing for at-risk students from over 20 school districts in Connecticut a state-of-the-art computer-based writing curriculum. Through high quality instruction incorporating computer technology, the school is helping these students improve their written expression through process writing, desktop publishing, multidisciplinary instructional projects, telecommunications, and multimedia. The impact of the first year of the program on students' written language and self-esteem was assessed quantitatively and qualitatively by the presenter.

Telecommunications for Deaf and Blind

John-Mark Leach
Florida School for the Deaf and Blind
St. Augustine, Florida

Abstract

The goal of the Computer Resource Center, located on the campus of the Florida School for the Deaf and the Blind in St. Augustine, is to provide services which would enhance the hearing-impaired students' academic potential through the use of computer technology. This goal is presently being met by providing state-wide services in three main areas: a) providing teacher inservice; b) sponsoring teacher and student activities, c) coordinating special projects. In addition we work closely with the Florida Instructional Material Center to provide in-service training and support to teachers of the visually impaired throughout the state of Florida.

It was with these goals in mind that we developed our Telecommunication Apple Grant (TAG). This grant allowed us to have our hearing-impaired students telecommunicate with hearing students. Our telecommunication activities took place in real-time in an effort to improve the language skills of our hearing-impaired students. Visually-impaired students had a completely different need which focused on accessing current information in an independent manner. This objective was met by using specialized telecommunication software with voice output, and providing students with the skills necessary to connect to local, state and national bulletin boards. In addition to incorporating parts of these methods not in our current curriculum, our staff gained a great deal of technical knowledge by problem solving numerous issues associated with telecommunications. Without a doubt, this grant assisted our hearing impaired-students and our visually-impaired students, and gave our staff the confidence to attempt even bigger projects.

Projects (W1-10)
Math

Fundamental Skills Training Project: Three Intelligent Tutoring Systems

Kurt Steuck
Brooks Air Force Base
San Antonio, Texas

Laura Niland
Mac Arthur High School
San Antonio, Texas

Abstract

As part of the Fundamental Skills Training (FST) project, Armstrong Laboratory is designing, developing, evaluating, and transferring three intelligent tutoring systems (ITSs) in mathematics, writing, and science to public education over the next four years.

The first intelligent tutoring system is a Pre-algebra word problem tutor. The tutor guides a student through heuristics of defining the problem, representing the problem, solving the problem, and reflecting back on the problem solving process. Students use several different interfaces to define the goal of the problem and the data given in the scenario, build tables using a spreadsheet, construct graphs, draw simple diagrams, make and solve equations, and write about their problem solving using a word processor. This ITS has been implemented in 16 sections of Pre-algebra at a high school in southern Texas this academic year.

The second tutor is to facilitate the development of critical reading and writing skills. The tutor will guide students through reading, prewriting, drafting, revising, and editing phases of the writing process. The third tutor in this project is a science tutor. The writing and science tutors are in design and development.

Simulations Your Students Can Program

Elbert Bassham
Marfa, Texas

Abstract

Abstract not available at press time

Courseware Using Windows Technology for the Function Mathematics Concept

Eduardo Rivera and Evelyn Haddock
Inter American University of Puerto Rico
Hato Rey, Puerto Rico

Abstract

Windows has been the development platform of the 90's. Why not use this application in courseware? We did! The teaching of function concepts is complicated since one concept is related to the other. Managing more than one window is helpful to understand the inter-relation between concepts. In order to facilitate the use of courseware among non-computer literate users we used a friendly interface such as Windows. We used the same metaphoric structure that Windows used in the help menu to maintain familiarity.

We implemented hypertext using Knowledge Pro within the Windows environment to relate the concepts. With hypertext the student can navigate through all the concepts of a lesson. All the explanations of a screen are linked through keywords to other screens. This is easily achieved through index files of keywords and a pointing driver (such as for the mouse). The student feels free to navigate among concepts and among screens without the rigid sequence imposed in the classical approach.

This project was funded through the Resource Center of Science and Engineering in Puerto Rico. The results achieved were very promising and enthusiastic.

Using Spreadsheets as a "Visual" Manipulative for Teaching Basic Math Concepts

Jane Rosenberg and Lynn Shevelenko
Barat Colleg
Lake Forest, Illinois

Abstract

Many middle school, high school and college students encounter significant problems trying to master basic math concepts. Many of these students have poor understanding of underlying concepts such as signed numbers, powers of ten, the meaning of division and fractions. These difficulties are often accompanied by, poor memory for math facts and sequence of steps in calculation.

We developed a system of preformatted spreadsheet templates to address these weaknesses while preforming the educational role of manipulable objects. The value of using manipulable objects to help children internalize math concepts has been well documented. Yet, many secondary and post-secondary students are unwilling to use objects to help themselves master basic math. Computer spreadsheets, like physical manipulables, offer a way to concretize math concepts and help students visualize principles. The built-in calculation features of spreadsheets remove the burden of computation, allowing students to focus on pattern and concept recognition.

This template strategy is a low-cost yet effective way of helping students discover and own basic mathematical patterns and concepts. Using this strategy, teachers can easily develop their own templates without much programming experience. Furthermore, students can become aware of the procedural knowledge necessary both for math computation and for computer programming.

Projects (W1-11)
Networking Environments

Teaching Writing on Local Area Networks: A TCET Workshop

Hugh Burns
San Antonio, Texas

Abstract

This first Texas Center for Educational Technology (TCET) workshop on "Teaching Writing on Local Area Networks" was held in June 1991 and provided hands-on instruction for nineteen, K-12 teachers who emphasize writing processes in the language arts classroom. The workshop was sponsored by the TCET and the Texas Education Agency. Many of the teacher-participants now plan to use networked writing environments. All had the opportunity to design a "bright instructional idea" which would take advantage of these innovative teaching methods. This project presentation, therefore, (1) summarizes how our objectives were met, (2) presents evaluations of the teacher-participants, and (3) recommends a few ways to improve such workshops in the future. Such teacher training workshops provide models for collaboration,cooperation, learning, and knowing. Given Texas' initiatives for innovative teaching practices through appropriate uses of technology in the language arts, workshop participants accomplished the following objectives: (1) hands-on instruction for K-12 language arts teachers who emphasize writing processes in the language arts classroom and who also plan to use and perhaps design innovative software in networked writing environments; (2) demonstrate ways language arts activities can be designed to enhance teaching the writing processes: prewriting, arranging, revising, editing, proofreading, and publishing; and (3) imagine and discuss the future of writing instruction, educational technology, networked writing classrooms, teacher training in language arts, and collaborative learning. The participants developed on-line journals responding to the daily issues as well as the "bright idea" for a LAN-based language arts curriculum. In general, the teacher-participants exhibited enthusiasm over the ideas. Among the several recommendations were: (1) establish an electronic network for continued communication among the participants *and their participating regions*, e.g., TENET; (2) provide more ways to help regions make the next "right" step, and (3) consider more opportunities for teachers from similar grade levels to collaborate.

Homer Organizes Maximum Expectations Regularly (HOMER)

LaJean Rousset and Norman Traylor
Beaumont Independent School District
Beaumont, Texas

Abstract

Homer Drive Elementary School is a model school site that illustrates a distributed integrated learning system with three computers and a printer in every classroom in the school connected by two fileservers. All 765 students receive a minimum of 30 minutes per day of computer-assisted instruction. A large percentage receive more time with cooperative projects, library instructional computers, and creative scheduling. The library has a mini-lab of 10 computers designed for research stations, teacher training, and telecommunications projects. Work stations are in the principal's office to access network in order to retrieve student and teacher data.

Courseware focus is on critical thinking, decision making, problem-solving skills, integration of writing across the curriculum, and inclusion of interdisciplinary content. Management has three levels of access to allow adminstrators, teachers, and students extensive flexibility and comprehensive student reports.

Computer Integration Curriculum Committee plans staff development for integrating the technology into the curriculum and dissemination of information to teachers. Each teacher is an "expert" in one particular piece of courseware and is responsible for sharing the knowledge with other staff. Teachers empower student "experts" in the classrooms. Teachers and students work cooperatively to create a powerful working environment.

The Transparency of Technology in a Networked Middle School

Patsy Lanclos
Spring Branch Independent School District
Houston, Texas

Abstract

Yes, I Can! is the attitude that permeates through the Northbrook Middle School in Spring Branch School District, Houston, Texas. Technology is the tool with which students write, draw, compose, present, publish, research, calculate, predict, and communicate. In each classroom, students can use one of the 394 Macintosh LC computers which are distributively networked together. The use of an integrated software package enables the student to brainstorm, create and illustrate lessons either in groups or individually. Access to a twelve-modem pool via the network provides opportunities for the students to participate in a global society. Research is done in the state-of-the-art library using a computerized card catalog, electronic encyclopedias, or CD ROM and Laser disks in addition to the traditional hardcopy materials of a library.

Teachers benefit from technology and increase their efficiency by using electronic grade books, attendance reporting and electronic mail. Not only weekly bulletins, daily notices, and special attendance notices are posted, but also emergency or security notifications are transmitted via electronic mail. Parents benefit from the technology because of the opportunity to access each teacher's homework hotline and voice mail.

Electricity and excitement for teaching and learning are evident at Northbrook Middle School. The cooperative, collaborative environment enables students to be active learners. Technology is used in every arena including fine arts, industrial arts, foreign language, special education, health fitness, as well as mathematics, science, social studies, and science. Technology is the added value, the tool that ignites the spark for learning at Northbrook Middle School.

Special Presentation–ISTE (W1-12)
Textbook and Technology Innovations

Barbara Kurshan
Vice President, Educorp Consultants
Roanoke, Virginia

Abstract

How will textbooks change in the future because of technology, particularly multimedia? What information will be presented and how will it be presented? Because of the proliferation of multimedia hardware and software products, the way information is being presented in changing. A powerful evolution is merging educational technology and our printed textbooks. This panel will discuss the future of classroom textbooks and what strategies publishers and state departments of education are taking to incorporate these changes. Topics covered will include:

- Adopting new technologies as "textbooks"
- State Department partnerships with publishers and software developers
- New multimedia products for "textbook" adoption
- Future technical developments for the merging of texts and technology
- Using the new technology innovations as "textbooks"

Panelists:

Debbie Adams
Oklahoma Department of Education
Administrator, Textbook Section
Oklahoma City, Oklahoma

Dave Brittain
Florida Department of Education
Director, Office of Educational Technology
Tallahassee, Florida

Michael Hodges
Glencoe Division, Macmillan/McGraw-Hill School Publishing Co.
Executive Editor, Computer Education
Columbus, Ohio

Ted May
Optical Data
Vice President for Business Development
and State Adoption Consultant
Warren, New Jersey

Projects (W1-13)

Gender Equity Issues

No Boys Allowed! Promoting Computer Use for High School Girls

Theresa Cuprak and Jill Jones
Carl Hayden High School Center for Computer Studies
Phoenix, Arizona

Abstract

Despite efforts by instructors to encourage female students to enroll in advanced classes at Carl Hayden High School each year we are faced with an extremely unbalanced male to female ratio in our upper level computer science courses. Although the girls possess the necessary thinking skills to succeed in these courses, they typically do not have the same computer experiences and background knowledge as their male counterparts. The things that the boys talk about (BBS's, games, Norton Utilities, DOS secrets, the latest hardware crazes, etc.) are a mystery to the girls who are not part of this particular subculture. Although an understanding of these topics is not needed to succeed in computer studies, many very bright girls feel inferior and intimidated because they lack such knowledge. It is this uneasiness and the widely held stereotype that computers are for boys, that leads many girls to choose business applications over programming.

To counteract this alarming trend, we started a Girls Computer Group. Two times a month, the lunch time computer lab is strictly off limits to male students and teachers. Girls are given special invitations to come and learn about computers in a non-threatening environment. We introduce them to typically male-dominated areas, such as the BBS, the VAX mainframe and the latest hardware out there. The girls become familiar with computer jargon and become comfortable working with common utilities and DOS commands. Plans for the year include inviting female computer professional and Carl Hayden graduates to come and "rap" with the group about life after high school. We plan to pursue scholarships and grants that may be available for the girls.

Urban Technology: One Computer in Every Chapter I Class

Sharon Bell and Marilee Waguespack
New Orleans Public Schools
New Orleans, Louisiana

Abstract

In a true collaborative, Information Technology, Chapter I, and Curriculum and Instruction staff members designed and implemented a schoolwide project. In this project, schools that were designated as entire Chapter I schools with at-risk populations used Chapter I funds to equip the classroom with empowering technologies. The project focused on developing higher order thinking skills using the writing process in grades pre-K through sixth. Extensive staff develpment and classroom coaching were employed. Technologies included a computer, an overhead projector, a printer, and a sophisticated projection panel. Supporting software included word processors and writing extenders. This session will highlight the critical factors in designing, supporting and implementing a successful non-traditional technology project in an urban district.

Girls and Computer Technology—Maintaining an Interest

Jayne A. Kasten
Pattonville Holman Middle School
St. Ann, Missouri

Abstract

Excitement and enthusiasm—that's what middle school is all about, at least from the student point-of-view! "Keeping Young Women Interested in Math, Science, and Technology" was the title of an American Association of University Women grant which permitted the Female Electronic Marvels Club "model" to be studied and to create groups in other area schools.

An innovation begun in 1985 called the Female Electronic Marvels Club (or the acronym F.E.M.) for the purpose of encouraging young women to become involved in computer technology, this model was successful for the first four years of the club's existence. The "spark died" as interested waned during the 1988 school year. In 1989, the club didn't organize due to lack of interest and other difficulties. In 1990, because of the AAUW Eleanor Roosevelt grant, F.E.M. became a SPECIAL ORGANIZATION which meets before school at 7 a.m. The organization was revitalized with enthusiastic ideas and innovative projects aimed at interesting our young women in career options in math, science, and technology.

Female Electronic Marvels GOALS are to:

- Maintain interest of young women in math, science, and technology;
- Promote creative computer project for future careers;
- Lend opportunities for cooperative interaction between district and desegregation students;
- Maintain computer equity
- Create enthusiastic activities which motivate young women for continued study.

Special Window (W2-01)

Make All America a School: Cable Television and Education

Jim Ginsburg
Chief Information Officer, Mind Extension Univeristy
Englewood, Colorado

Abstract

The cable television industry's role in education is on the increase. Industry-wide initiatives such as the Cable Television Alliance for Education demonstrate a new commitment to that expanding role. Mind Extension University: The Education Network is pioneering pre-college and degree offerings available not only in schools, but in homes, businesses, and at a variety of other sites. The delivery system for secondary and college educational opportunities make use of advanced and innovative technologies. Use of computers, television, telephone and interactive media is used with students and teachers throughout the United States. Combinations of technologies compliment each other to effectively deliver educational programming.

Special Presentation - Panel (W2-02)
Copyright and Intellectual Property Rights

Marilyn Zajuderer
Apple Computer, Inc.
Cupertino, California

Abstract

Abstract not available at press time

ADAPT Spotlight (W2-03)
Opening Windows with Augmentative Communications

Scott Tooke
Fort Worth, Texas

Abstract

Scott Tooke is a college graduate who uses a Light Talker augmentative communication system. He will be speaking to participants about his experiences with technology in the university setting as well as in the public school system. He will discuss how technology has opened "windows" for him and where it is leading him into the future. Topics for discussion include what "windows" have been opened through the use of augmentative communication, what adaptations were made for Scott in the classroom, what obstacles exist when using technology, and what the future holds for Scott and others as a result of using augmentative communication. He hopes to have a positive influence upon those participants who are enthusiastic about implementing augmentative communication into the classroom.

Special Presentation–Panel (W2-04)

Supercomputing, Computational Science, and High-School Education

Nora H. Sabelli
National Center for Supercomputing Applications
Champaign, IL

Abstract

This panel is a forum to discuss ideas and forge collaborations among attendees interested in using computing techniques for science, mathematics and computer science high-school education.

SuperQuest is an NSF-funded national research competition for teams of high-school students and teacher-coaches, designed to promote awareness of supercomputing and of computational science. Several issues related to the four-year SuperQuest experience, and its relation with other national and state computational science high school competitions will provide a basis for discussions between the panelists and attendees:

- Supercomputing in high-school: why do it? what does it require from the school, from teachers and students?
- Examples of successful computational science projects in high school
- Role of teacher-coaches
- Role of scientists and engineers as mentors
- Internet networking for high-schools
- Development of regional computational science competitions

Panelists:

SuperQuest Program:
Helen Doerr
Cornell Theory Center
Ithica, New York

John Collins
Camarillo High School
Camarillo, California

Alabama High School Computational Science Program:
John Ziebarth
University of Alabama
Huntsville, Alabama

Special Presentation-EDUCOM (W2-05)
Myth to Vision

Steve Gilbert
Vice President, EDUCOM
Washington, DC

Abstract

We need to understand our past and create our future. The panelists have worked together to exchange ideas and information from their disparate sectors:

- Higher education academic computing
- College stores and information technology resellers
- Community colleges technology programs
- The publishing industry.

Together, the panelists will provide a brief review of relevant "myths" about how we developed and delivered information technology-related resources in the past. More important, we will offer a multimedia synthesis of four different perspectives on a vision for our future. We will continue to work with dozens of collaborators electronically to develop a consensual description of several scenarios that will be proposed as both feasible and desirable.

In the first phase of this project we identified the following five themes to serve as the foundation on which we will form our vision scenarios:

1. Universal access to information through information technology,
2. Lifelong learning through information technology,
3. Learning style preferences of individuals matched by modes of presentation, communication, and control available through information technology systems,
4. Citizenship information and communications needs met through information technology systems,
5. Integration of the relevant divisions within education (e.g. academic computing, library, college stores, etc.) and integrationof relevant sectors of society (e.g., higher education, publishing industry, information resource services, libraries, K-12, etc.)

Attendees will be asked to join the third year of electronic collaboration to help us further evolve our Vision.

Paper (W2-06)
Network Activity Stages: Organization of Successful Electronic Collaboration and Communication

Clinton E. Stapleton
University of Illinois
Champaign, Illinois

Abstract

This paper reports findings from a study which critically analyzed network activity stages of successful learning activities conducted over a nationally and internationally linked electronic network to find out how effective communication and collaboration are organized. In this study electronic network messages exchanged between distant educational activity collaborators were classified into the following network stages: (a) proposal, (b) refinement, (c) organization, (d) pursuit, (e) wrap-up, and (f) publication. The frequency of messages exchanged for each stage was tabulated and the sequence of network stages was graphed for each network learning activity. Results supported the existence of network activity stages which follow a sequence with fluctuations between some stages. Recommendations are made for designing network interfaces, software tools, training, and projects that are sensitive to network message audiences, network activity stages, and network activity duration, and message flow. This analysis of social interactions and communications has important implications for designing, developing, and using electronic message systems for successfully supporting communicative, collaborative, and learning activities among participants isolated and disenfranchised by distance, resources, and their environment and integrating telecommunications supported activities into school curricula.

Introduction

Social scientists (Levin, Rogers, Waugh, & Smith, 1989; Riel, 1990; Waugh & Levin, 1989) have reported a significant growth in the number of non-technical users of electronic networks who participate in educational collaboration. Teachers and students who are separated by long-distances are using networks to collaborate, communicate and exchange data (surveys, scientific experiments, questionnaires, newsletters) in ways that are more effective than other existing means (Levin, 1990). While some participants describe successful interaction with distant correspondents, others try, fail and give up in frustration. One major problem is while the technology exists for communicating and collaborating over distances, we still know very little about the human factors of how to organize activities on electronic systems (Newman, 1990). An important problem has to do with the process of conducting collaboration and communications on distributed electronic networks. It has been reported that many network activity proposals are ineffective in motivating students and teachers to respond and participate, while others that receive responses fail during the later stages of the activity life cycle.

Teachers are faced with problems of integrating network-based instructional activities into school curricula and the classroom environment. Examples of problems encountered by teachers who decide to integrate a network-based instructional activity in the classroom include finding interesting educational network activities in which to participate, finding out what other project participants are doing to successfully integrate on-going projects at their local site, and finding out about educational network projects that have been successfully implemented by students and teachers. With the current increase in network use by classroom teachers, students, librarians, and other non-technical professionals, there is a need to understand better how to use networks appropriately for instructional collaboration. In order for networks to be useful as an effective educational medium, teachers need to know how to successfully design, organize, conduct, and and integrate network-based instructional activities in a manner that motivates students and network participants and supports effective and efficient educational communication and collaboration.

Purpose of the Study

The purpose of this study was to investigate the social organization and human dynamics of network communicative and collaborative educational activities by critically examining the network stages and sequence that exist for successful network learning projects.

Background: Network Activity Stages

Educational network activities can be described according to the stages they go through. Levin, Waugh, Kim, and Miyake (1990) suggest that the stages in the life cycle of a newly proposed activity on FrEdMail can be described as: (a) proposal, (b) refinement, (c) organization, (d) pursuit, (e) wrap-up, and (f) publication. To illustrate what each stage entails, a network activity called the Noon Observation Project will be used to explain the classification proposed by Levin, et al.

The Noon Observation Project is an educational activity carried out successfully several times on FrEdMail. It was targeted at junior high and high school math, science, and social science classes. Participants in various locations world-wide use FrEdMail to replicate an ancient scientific experiment originally conducted in Egypt over 2,000 years ago by Eratosthenes of Cyrene (276-195 BC).

Eratosthenes made a measurement of the earth's north-south circumference that had an error of only 10% to 15%. He accomplished this by developing a method which involved calculating the angle of the sun during the first day of summer (the Summer Solstice). Eratosthenes used calculations collected from sites located on the same meridian. He then applied geometric calculations to arrive at an estimate of the circumference of the earth.

The Noon Observation Project required students to collaborate with other student partners in distributed distant locations to collect real data from their sites, communicate, and calculate the circumference of the earth. Students made simple measurements of the sun's shadow at local noon time, analyzed the data, shared data with student partners at other sites, and calculated the circumference of the earth.

Proposal Stage

Levin, Waugh, Kim, and Miyake (1990) report that the first stage (proposal) of a new activity is characterized by the posting of a message on a bulletin board (called $IDEAS) describing an idea for a network-based learning project. $IDEAS is a bulletin board on FrEdMail that serves as a place for posting calls for collaboration. The message below is a project proposal that was posted on $IDEAS by an educator to recruit participants for the Noon Observation project. It represents typical messages exchanged during the proposal stage.

To: $IDEAS
From: [Teacher]
Subj: Noon Project

Following is the description of an interesting project for junior high and high school math, science, or social science classes. This project involves students in making simple measurements of the sun's shadow, analyzing the data, calculating the circumference of the earth, and sharing the data and results with students at the other participating sites. This project was suggested by [Educator], and several sites on the FrEdMail network have successfully participated in a set of observations in the past. We would like to run this project again this fall, and invite you to join us.

Project name: The Noon Observation Project

Purpose: Use simple measurements and calculations to determine the north-south circumference of the Earth.

Content area: Math, trigonometry, elementary statistics, science & social science.

Background: Over 2,000 years ago Eratosthenes made a remarkably accurate measurement of the earth's north-south circumference. This project requires collaboration of students in places at different latitudes of the earth to make some simple measurements, share data, problem solve the algorithms required, and then replicate and share their results. This is a real, practical experiment which may provide lots of practice making measurements and using trigonometry and statistics.

General Procedures:

1. At least two sites must collaborate whose latitudes are different enough to give a significant difference in measurements.
2. On the given dates (or within a day or two on either side, depending on weather conditions) students will conduct their measurements outdoor at high noon, local time. Local time must be used, as the sun varies in altitude depending on location within your standard time zone. You can use this observation to discuss the whole concept of time zones, geographic location, etc.

[5 steps, additional details on how to participate, deadline to respond and date results were to be shared were included in the message above].

Once an activity proposal has been posted on the electronic bulletin board ($IDEAS), teachers, students and/or other interested parties respond and the activity moves on to the next stage or there are insufficient responses and the proposed activity comes to the end of its life cycle. Levin, Waugh, Kim, and Miyake (1990) have observed that on FrEdMail a majority of the new project proposals never get a response and as a result end their life cycle at the proposal stage.

Refinement Stage

The refinement stage occurs as soon as interested parties begin sending messages to the original proposer and each other to refine the proposed idea so that it becomes meaningful to all those involved. This allows for participants to contribute in the final shaping of the actual activity to be carried out. The message below is a follow-up from an interested teacher who responded to the proposal message to recruit participants for the Noon Observation Project. It represents typical messages exchanged during the refinement stage.

To:[Educator]
From; [Teacher]
Dear [Educator], October 27th, 1990

I have just downloaded your memos on the noon project and am interested in taking part. Does the spread sheet you made provide for people in Australia to enter their readings? Is Lauriston the Australian site you mention? I can't find their address in AGE$. I haven't used a spread sheet before but I will ask for local help when you advise on the spread sheet applicability for the southern hemisphere.

Regards, [Teacher].

To facilitate these network interactions and future communications, often a "conference" or mailing list of interested participants will be set up by the proposal originator who often assumes a leadership role.

In this way a message can be sent to all members by simply addressing it to the conference name (i.e., $NOON Conference, $LUNCH Conference, $PLACES Conference) instead of the individual names and addresses of project participants (i.e., UIUCED!APETERS, UIUCED!TJAMES, UIUCED!MWALKER, UIUCED!KBROOK,etc.).

Organization Stage

Stage three, organization, occurs after activities have been proposed and/or refined. After an activity proposal has been accepted by a sufficient number of interested participants or following an activity proposal that has been successfully refined, activities need to be organized and sometimes progress to the organization stage. Those that go unrefined may come to the end of their life cycle at the refinement stage. At the organization stage messages are exchanged containing specific details about the activity: (a) time schedules, (b) detailed descriptions of planned procedures, and (c) exchanging of resources (software, instruments, materials, background information, etc.) to facilitate the organization.

The message below was sent to participants of the Noon Observation Project ($NOON) by the teacher [Teacher] who had taken the responsibilities of organizing the implementation of the project and coordinating participants and network-related activities. It represents typical messages exchanged during the organization stage.

To: $NOON
From: [Teacher]
Sent: 10/28/90 6:27 AM
Rcvd: 10/28/90 6:40 AM
Subj: How to do Noon

Here are some final hints for taking the noon observations on Thursday and Friday, Nov. 1st and 2nd.

Place: Find a flat hard surface to make your observations, that will be sunny in the morning. A playground works, as long as it is horizontal. A quiet sidewalk would also work.

Materials needed: For each observation station you plan to set up, you'll need a meter stick, a book-end, some connected sheets of computer paper, and masking tape. Tape the sheets of computer paper to the ground, oriented so that the shadow of the meter stick can run along the length of the paper. You'll need about 4 sheets for the lower 48 states or Australia; more for higher latitude places. Tape the meter stick vertically to the book-end, place the book-end and meter stick on the end of the paper toward the sun, tape it down to the paper, and mark the bottom inside corners of the meter stick on the paper (inside means toward the shadow).

Fuzzy shadows: Don't be surprised if you and your students find the meter stick shadow's edge to be fuzzy. The longer your shadow, the fuzzier the edge. This is due to the fact that the sun is not a point light source but instead a disk. This is not a problem as long as we all consistently decide on where to define the shadow's end. The easiest direction for students to follow is to mark the end of the darkest part of the shadow - the place where it starts to get fuzzy.

Timing: Plan to allow 10-15 minutes for set-up. Then start making observation 10 minutes before local noon, and collect data once a minute for 20 minutes. You can call out the time to mark each minute ("Mark"), and have your students put an X at the end of the shadow at that time. When your students have completed their observations, have them collect all the equipment and take it inside. They can use the same meter sticks to measure the shadow lengths (after they've un-taped them from the book-ends!). You may want to have them do the measurements right away, or you may want to do that at some later time.

Hope for some sunny days!

Pursuit Stage

Pursuit involves the actual implementation of the activity. It is during this stage that descriptions of problems which arise as well as messages with reports of progress are exchanged over the network. This also includes any classroom or outside debate, discussion and data collection that is done in order to solve problems and engage in learning through participation and collaboration with experts or peers.

The message below was sent to participants of the Noon Observation project ($NOON) by a teacher and class [Teacher] who have taken the responsibilities of collecting data from their local site and sharing it with distributed distant partner classes ($NOON) on the network who are also collecting and exchanging data to carry out the Noon Observation project. It represents typical messages exchanged during the pursuit stage.

To: $NOON
From: [Teacher]
Sent: 11/09/90 5:03 PM
Rcvd: 11/10/90 3:36 AM
Subj: Data

Hello Noon Friends,

The following measurements were taken by elementary children in second and third grade on November 1, 1990 at [Elementary School Name] in Urbana, Illinois.

TIME	*GROUP 1* Measire,emt (in cm.)	*GROUP 2* Measurement (in cm.)
11:27	140	135
11:28	137	132
11:29	136	130
11:30	135	127
11:31	138	138
11:32	137	142
11:33	133	134
11:34	135	140
11:35	132	144
11:36	135	133
11:37	134	135
11:38	135	138
11:39	138	135
11:40	134	148
11:41	135	136
11:42	138	135
11:43	137	150
11:44	136	143
11:45	133	136
11:46	137	135

Local noon time: 11:37
Latitude: 40 degrees north
Longitude:88 degrees west

This was a group of students from an after-school FrEdMail class. On November 1st they were divided into groups with 3 or 4 students per group. The wind made it very difficult to get accurate marks which probably accounts for the fluctuations in their measurements.

Wrap-up Stage

The wrap-up stage is sometimes difficult to differentiate from the pursuit stage. In fact some activities do not have a wrap-up stage. The wrap-up stage is often characterized by some form of a thank you message sent to participants from the original proposer which may provide a brief final report and/or the contributions of the participants.

The message below is sent to participants of the Noon Observation Project ($NOON) by the teacher [Teacher] who had taken the responsibilities of organizing the implementation of the project and coordinating participants and network-related activities. It represents typical messages exchanged during the wrap-up stage.

To: $NOON
From: [Teacher]
Sent: 01/22/91 6:16 PM
Rcvd: 01/22/91 6:47 PM
Subj: Final Tallies

Dear Noon Folks,

It was brought to my attention recently that some of you may not have received the final results from our project. I know some of you did your own calculations, but in the attached files you will find comparisons for five of the sites that participated (file #1) and a copy of the final report from my classes (file #2).

I must apologize for the lateness of these results, our node crashed and I was unaware that some messages were lost as a result. Once again let me thank you for participating, and I hope to work with you again on this project next fall. If you have any projects going that you would like my class to join just let us know.

More later, (Teacher's Name)

(The following file was attached to the message above)

Here are the computations of the circumference of the earth between five of the participating sites. It should be noted that the data from Alaska was reported by them to be a bit disappointing because the day was overcast and the end of the shadow was hard to determine. Also the data from some other sites was not compared since they took the measurements at 12:00 noon rather that 'actual' noon (i.e. the highest point of the sun in the sky) I think all of the students involved in the project can be very pleased with the accuracy they achieved.

I had a very good discussion with my classes about why our measurements were so much more accurate with those sites at the furthest north-south distance from us. I think they began to see that as distances increased, the importance of accuracy in measurement decreased. When we study ratio and proportion in the next quarter I will again raise this project as an example.

Please let me know if you have any further questions or comments about the project this year. We hope to make this an annual event, and hope you will join us again next time.

The next file is a copy of the final report that I posted a while back that tells about how my classes compiled and analyzed their data. Once again, thank you all for participating in the project this year and making it such a success!

[Teacher] [Middle School] Champaign, IL

[A file was attached to this message and included a description of the project implementation]

Publication Stage

Publication is the last stage for some successful projects. Here the participants post messages about the activities' content, not just to themselves but to a broader audience on the network. This allows new and existing network users to find out about a successfully implemented project. The message below was posted on the $IDEAS and $HILITES bulletin boards so participants who did not contribute in the implementation of the Noon Observation Project could find out what was done to successfully implement the project. It represents typical messages exchanged during the publication stage.

To: $IDEAS, $HILITES
From: [Teacher]
Date: 12/13/88
Subj: Report of the Noon Obs. Project

This is the final report of another trial of the Noon Observation Project, suggested by [Educator]. We conducted our observations at the beginning of November, exchanged data, and here is our report of our analyzes.

Noon Project Final Report

Here is a wrap up from Columbia Middle School on the Noon Project of November 1988. Let me begin by saying that it was just as much fun, and perhaps a bit more educationally rewarding this year as it was last. There were a few minor changes (hopefully improvements) from last year's project.

Firstly, I have two sections of Pre-Algebra this year, and I wanted both to participate. So I had one group take the data, but both groups analyzed it. There was a marked difference in the groups' reactions to the final figures and their interpretation of the errors. (More about that later.)

The procedure for taking the data was the same as last year. We divided up into groups of three and using a meter stick taped to a book-end we cast shadows onto computer paper. We took fifteen one minute interval readings, trying to bracket noon, on two consecutive days. We had seven groups each day, but produced only six good groups of data per day. What follows is how each class arrived at the angle they sent off for the final computation of the circumference.

Signed, [Teacher] [Middle School] Champaign, Illinois

[A detailed description followed which included what was done to implement the project].

Method

A number of successful projects on the FrEdMail network (a grassroots school-based electronic network) were investigated to address these research question. Nine hundred and twenty two project proposals posted on an electronic bulletin board on FrEdMail between January 1989 and June 1990 were examined and 43 were selected by using researcher designed criteria. Sixteen projects were judged as successful by participant self-evaluations of the projects and evaluation by editors of the "HILITES" bulletin board on FrEdMail, and these were selected by the researcher for intensive study. Messages and files exchanged on the network, diaries of network usage, and summaries were collected on the 16 projects. Telephone interviews were conducted to gain information that was not captured in the network messages or from materials used in the projects.

Each network project was described along the following dimensions: (a) purpose of the project, (b) origin and formulation of the project idea, (c) recruitment of participants, (d) reasons for participant's interest in the project, (e) refinement of the proposed idea, (f) organization of the project, (g) implementation of the project, (h) context and resources, (i) wrap-up of the project, (j) outcomes of the project, (k) problems of the project, (l) recommendations for improving the project, (m) reasons the project was successful, (n) sequence of network stages, and (o) volume of network messages.

Network messages were classified into the following network stages: (a) proposal, (b) refinement, (c) organization, (d) pursuit, (e) wrap-up, and (f) publication. The frequency of messages exchanged for each stage was tabulated and the sequence of network stages was graphed for all projects. The volume of network messages sent and received by activity participants (and bulletin boards, when applicable) was graphed for each project.

Results

Analysis of the sixteen successful projects show that network stages proposed by Levin et al. existed and that two patterns were present that described the progression of successful network activity stages. The first pattern (Figure 1) shows that many successful network projects start at the proposal stage, fluctuate between the middle stages (refinement, organization, pursuit) as the project progress, and stabilize when they get to the wrap-up or publication stages. This usually is characteristic of projects that are not survey-based or require quick, short or a few responses from interested network participants.

These projects usually fluctuated between the refinement and organization stages early during the implementation of the project and between the organization and pursuit stages during the latter part of the project implementation. Fluctuation is less evident during the latter part of the project implementation than the earlier part because of interested network users who request to be added to the project once it has begun. It was observed that for most of the successful projects though there may be fluctuation in the middle stages the pursuit stage was fairly dominant and consistent in comparison to other middle stages (Stapleton, 1992). Figure 1 shows the sequence of network stages for the Noon Observation Project which serves as an example of the pattern described above.

The second pattern shows that some successful network projects start at the proposal stage and progress fairly smoothly to the wrap-up and publication stages where the project comes to the end of its life cycle (see Figure 2). This usually is characteristic of projects that are survey-based or require quick, short or one to two responses from interested network participants or require participants to participate by responding to a prompt such as a questionnaire, survey, or project that exchanges writings, resources, or ideas that needed little or no refinement or organization of the idea, materials or managing of participants.

Analysis also showed pattern where messages at the extreme sages (proposal and publication) are targeted at a wider more general audience which includes the entire network audience or subgroups of that audience (participant description,

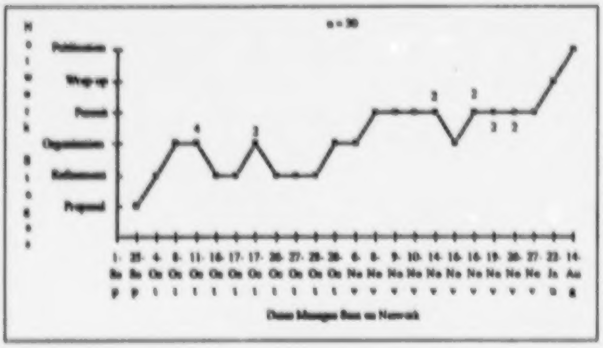

Figure 1. Network stages observed for messages exchanged during the Noon Observation Project 1990

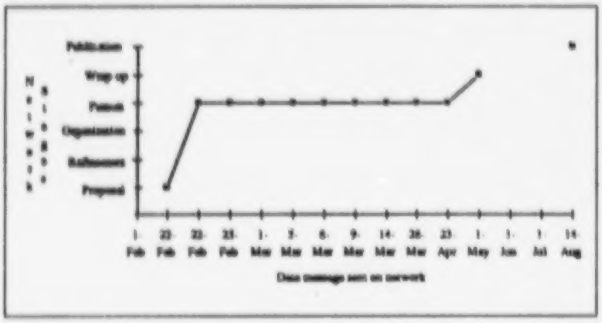

Figure 2. Sequence of network stages for the Weather Holidays Project.

content description, grade level) while those exchanged during the middle stages (refinement, organization, pursuit, wrap-up) are targeted at a more specific and focused audience that includes only those who expressed interest in participating in the project. This is evident in the organization of network activity progression from a bulletin board to mailing list (conference) to bulletin board structure. This format is used to support the general to specific to general nature of network messages exchanged by participants with content focused on various audiences.

Another interesting pattern was revealed as a result of analyzing the number of messages exchanged for successful network projects as categorized by network stages (see Table 1). This analysis showed that the most active stages were a high number of messages were exchanged included the middle stages (refinement, organization, and pursuit) and the least active stages include the outer stages (proposal, wrap-up, and publication). It was observed that the bulletin boards ($IDEAS and $HILITES) used at the extreme ends of projects facilitated the smaller amount of messages that were associated with a particular network project while the mailing list and conferences created and used during the refinement through wrap-up stages facilitated the higher number of network messages exchanged by project participants during the actual project implementation (Stapleton, 1992).

The wrap-up stage usually happened long after the last pursuit message was exchanged for almost all of the successful projects examined (see Figure 2). The publication stage was also observed sometime after the project was wrapped-up (see Figure 2). This stage was extremely important for assessing success because it was where the project implementation was published and shared with other FrEdMail users that did not participate in the project. Subsequently the activity report disseminated during the publication stage not only served project participants by briefing them on the implementation of the project but it also served non-participants as well (Stapleton, 1992.)

Conclusions and Recommendations

Network stages proposed by Levin et al. can be used as an organizing tool for managing network participants, coordinating resources, and activity-related tasks as evidenced by organization patterns of successful network activities (Stapleton, 1991). The existence of network stages among successful network activities has important implications for structuring activities not only on the FrEdMail network but on a variety of electronic message systems (educational, business, government). Bulletin boards, conferences, and mailing lists have important functions in supporting successful collaboration and communication. There can serve as a place to easily meet and recruit prospective activity collaborators from a diverse population of network users.

Conferences and mailing list can serve as tools for managing and organizing collaborators that met and committed themselves to a particular activity with focused tasks. A special bulletin board can be used as an electronic journal with the entire network as subscribers, readers, and contributors. Every network user should have access to the bulletin board so they can read successful implementation reports of activities. These successful activities can be submitted to an editorial board who reviews the activity, evaluates it, and decides whether it meets criteria for success as determined by the network audience. The activity could them be published according to a consistent format so that readers can develop expectations about the format and presentation of entries on the bulletin board.

Similar recommendations are made for creating a bulletin board or bulletin boards that are sensitive to the proposal stage, messages exchanged, and the general audience targeted during this network activity stage. Several tools could be created to support the social organization of participants as they meet others, advertise ideas, and recruit collaborators to participate in proposed network activities.

Electronic templates could facilitate these types of bulletin board-based activity and participant management and organization for both proposal and publication stages. This is because there are consistent elements observed in proposal and publication messages exchanged on the network. For example most of

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Table 1
Number of Messages Exchanged for Successful Network Projects by Stage

Activity name	*Proposal*	*Refinement*	*Organization*	*Pursuit*	*Wrap-up*	*Publication*
Noon Observation	1	6	10	12	1	1
Lunch Problem	1	11	1	9	2	1
Most Livable Places	5	9	21	31	-	1
Coded Messages	1	2	4	4	1	1
Global Grocery List	1	2	2	19	1	1
Geography Game	3	0	1	7	1	1
Weather Holidays	1	0	0	9	1	1
JokeBook	1	1	0	10	5	1

the successful project proposals examined included a title, subject area(s) covered, grade level targeted, purpose, and brief description of the project. This information was mostly communicated in a network message which was brief and about one computer screen in length. Most often an attached file followed with a more detailed description of the project for those who were interested in the project idea, target audience and content and were willing to take the time to inspect the proposed (proposal stage) or published (publication stage) project idea more closely.

The duration of projects, time lags, and fluctuations between stages suggest that network designers and developers who impact standardization and interface improvement as well as network participants, especially activity leader, coordinators, and moderators should be sensitive to these network activity processes and phenomenon. It is recommended that these individuals design and develop learning activities that take advantage of findings on the characteristics and patterns of electronic communication and collaboration described in this paper. There is a need for proposal and publication templates that are sensitive to network stages and their characteristics. These should be non-technically oriented and easy to use since most network users who participate in educational activities are students, educators and non-technical experts who have time and resource constraints among others.

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Paper (W2-06)

Graduate Education For Telecommunications Professionals: Some Hard Data on One Program's Long Term Impact

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Abstract

This paper reports the results of a recent study regarding the long term impact of a graduate level educational program in telecommunications jointly developed and administered by IBM Corporation and Pace University. All graduates from the first seven classes of the program were surveyed. These 175 students, all of whom graduated from the program at least six months prior to the survey, reported the impact that the program had on a number of domains, including: job performance; career advancement; development of enhanced interpersonal relationships; patterns of participation in formal education following graduation from the program. Planned as well as unanticipated positive outcomes were reported by students and are given in this paper.

Introduction

Over the past three years, the IBM Corporation and Pace University have jointly developed, offered and evaluated a graduate-level education program in telecommunications. The program, called the Graduate Telecommunications Program (GTP), consists of an integrated credit-bearing sequence of six courses designed to provide IBM internal telecommunications professionals with a solid academic background in telecommunications technology and management.

The effort has been an active partnership between IBM and Pace, which has resulted in a highly successful corporate program. Moreover, the six course sequence is an integral part of Pace University's Master of Science in Telecommunications degree program, which is offered through Pace's School of Computer Science and Information Systems.

Eleven offerings of GTP have been held since June, 1988, and approximately 275 students have successfully completed the program. Until recently, however, there was no concrete data on the long term impact that the program has had on the job performance, career development, continuing education, and attitudes toward the profession of program graduates.

This paper describes the results of a recent follow-up study of 114 GTP graduates, drawn from graduates of the first seven program offerings, who have completed the program between six months and two years ago. It was felt that this group would be able to provide a useful perspective on the value of the program now that at least six months had elapsed.

Before reviewing the follow-up study, it would be helpful to describe briefly the background, curriculum and structure of the program.

The Need For Telecommunications Education

Building and maintaining corporate telecommunication networks has become essential to competitive survival in today's information economy. These networks must provide for the effective and timely communication of voice, data, and visual information within the office, between company sites, and with the outside world.

Moving a large company to be more responsive to the changing needs of the business, however, is most challenging. Many new skills and attitudes are needed to support an orderly change toward doing business a new way. The movement toward network consolidation, integration and connectivity across the company requires that skills be upgraded and that a new perspective on the role of the telecommunica-tions function be adopted. Thus, education must be viewed as instrumental in promoting change.

In response to this need, the internal telecommunications organization within IBM issued a request for proposal (RFP) to the university community in September 1987. The RFP called for a generic graduate-level credit-bearing program. Pace University responded to the RFP in October 1987, and was informed that it was the successful bidder in December 1987. The development team of six persons from both IBM and Pace was formed, and work began in earnest in early January, 1988.

Program Objectives

The following broad program objectives were identified and used as guidelines for developing the GTP curriculum:

- To broaden the ranks of middle management and senior professionals with skills in telecommunications technology and management.
- To provide current information and understanding of the telecommunications field including terminology, key concepts, key issues, and trends.
- To provide the analytical tools and skills needed to manage the process of planning, designing, installing and operating telecommunications networks or network nodes in a cost-effective manner.
- To identify sources of information and tools for keeping abreast of key trends in the telecommunications field.
- To develop awareness of the telecommunications environment including governmental agencies, standardizing bodies, professional societies, and a multitude of telecommunications service providers.
- To establish a base of telecommunica-tions knowledge and attitudes to promote further study to include:
  a. Continuation of formal education toward an advanced degree in telecommunications,
  b. A foundation for lifelong study,
  c. An attitude of self-confidence and motivation to keep up with changes in the field after graduating from the program.

Program Overview

The curriculum of the Graduate Telecommunications Program is designed to blend academic subject matter with information based on IBM specific issues and direction. Selected case studies and computer-based simulations are used at several points to help integrate the concepts and disciplines learned in the program by providing a context for complex problem analysis and solving. The six courses that make up the GTP curriculum are as follow:

- Data Communications and Networks
- Computer Networking
- Digital Telephony and Switching
- Telecommunications Management
- Telecommunications Policy and Environment
- Cases in Telecommunications

A more complete description of the program and its curriculum are given in [Varden89].

The Faculty

Although many of the GTP instructors are Pace University faculty, every effort has been made to identify and secure the best avaiable person for each course. As a result, faculty from the University of Colorado, University of New Haven, University of Dallas, and several authorities from within IBM and other companies have taught in the program. In addition, a wide variety of outside speakers representing organizations such as AT&T Bell Labs, AT&T, and Sears Technology Services have contributed to the program.

Academic Credit

All students who successfully complete all courses receive eighteen (18) points of academic credit from Pace University. Two credit options are available: graduate credit for those who already have a bachelor's degree, and undergraduate credit for those who have not completed a bachelor's degree.

The Follow-up Study

GTP has consistently received high marks on exit evaluation surveys from its graduates and continues to have a long waiting list for future classes. But are these high marks nothing more than the euphoria of students who had just completed a rigorous program of study, or does the program have something of lasting value to offer?

To answer this question, both Pace University and IBM thought it would be valuable to conduct a survey of GTP graduates who had been back in the workplace for at least six months following completion of the program. The following issues were felt to be of particular interest:

- Has GTP contributed to improved job performance? If so, in what ways?
- Which one of the six courses of the program has proved to be the most valuable? Which the least?
- Has the knowledge gained through GTP contributed toward career advancement (promotion) or to an increase in the scope of job responsibilities?
- Do graduates keep in contact with fellow GTP classmates, and have the friendships that developed during GTP been of value in performing their job?
- Have graduates continued their formal education following completion of GTP?

Procedures Used in the Study

The survey was created and distributed using an online survey tool call IDSURVEY. IDSURVEY is an IBM internally written program specifically designed for administering electronic surveys to large numbers of employees on the IBM network.

Once created, the survey was distributed to 175 GTP graduates of the first seven classes on November 15, 1990. During the distribution process, system messages were received, indicating that the electronic mail box of some graduates had changed since graduating from GTP. This made it possible to update the distribution lists and ensure that all 175 graduates had in fact received the survey.

The survey took only about 15 minutes to complete, including additional write-in comments. Since the survey could be taken and returned online, there was no need to print and mail any hardcopy forms. Of the 175 graduates surveyed, 114 responses (65 percent) were received over a three week period.

Summary of Findings

A. Characteristics of Study Participants

The years of IBM service of the respondent group covered a wide range. Some students had been with the corporation for less than 5 years while others had accumulated over thirty years seniority. The distribution is given in Figure 1.

Respondents were further categorized by their job level. These levels reflect positions of increasing professional proficiency and responsibility and span the range between entry level professionals and directors. GTP has been populated by students from each of these levels.

Surprisingly, none of the 114 respondents was from the lowest two job level categories or the highest. From the intermediate levels, 30 were categorized as staff, 49 were advisory and 35 were senior.

B. Overall Value of GTP on Job Performance

The single most significant question the authors sought to answer was what the net, overall value that GTP students felt they received by participating in the program. Thus, a survey question asked "Which of following statements BEST describes the overall contribution that the knowledge and skills obtained in GTP have had on your job performance?

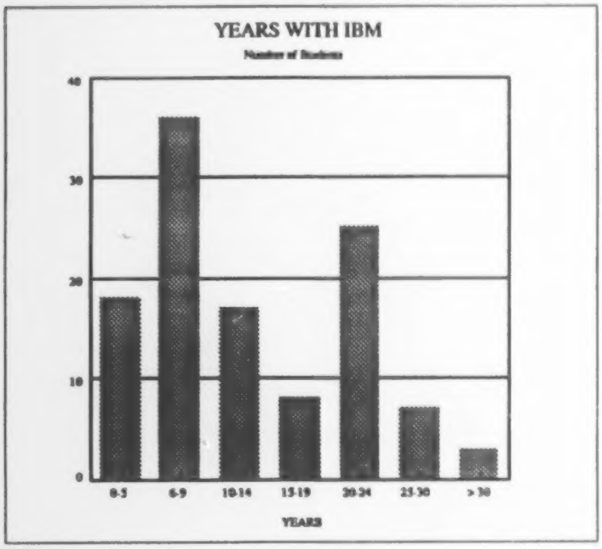

Figure 1

1. The contribution of GTP has been negligible.
2. GTP has resulted only in a marginal improvement in my performance.
3. GTP has resulted in a moderate improvement in my performance.
4. GTP has resulted in a significant improvement in my performance.
5. I could not possibly perform my job successfully without GTP."

Student responses were, indeed, quite gratifying. Over seventy-two percent (72.8%) of the respondents selected responses 3, 4, or 5 reporting that GTP had a moderate, significant or essential effect on their ability to complete their job responsibilities successfully. Marginal improvements in performance resulting from GTP were reported by 22.8% of the respondents and only 4.4% claimed that GTP had a negligible effect on them. These data are given in Figure 2.

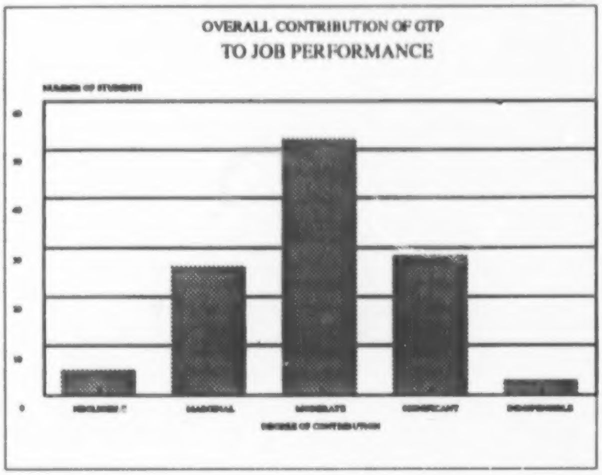

Figure 2

A second question addressing overall GTP value was posed to the students. It asked "How have the knowledge and skills taught in GTP contributed to your ability to perform your current assignment? (Choose as many as apply).

Choice 1:	GTP has provided me with a broad back ground of the telecommunications field.
Choice 2:	GTP helps me work more effectively on interde partmental projects.
Choice 3:	GTP helps me evaluate/prepare business cases."

Thirty-six (31.6%) of the students agreed with the first choice; sixty-two (54.4%) stated that either choices 1 and 2, 1 and 3, or all three choices were correct.

C. Impact of GTP on Career Advancement

To determine the effect that GTP has had on career advancement, program graduates were asked whether or not they had been promoted since they attended GTP. Of the 114 respondents, 36 (31.6%) had been promoted.

Of those 36 who had been promoted, 20 (55.5%) felt that the knowledge and skills acquired in GTP had been of some significance in their promotion; five (13.9%) felt that GTP was of great significance in their promotion; and one (2.8%) said that it was essential. In all, of the 36 who were promoted, 26 (72.2%) felt that the knowledge and skills acquired in GTP played at least some role in their promotion.

While a promotion is certainly one way to measure success, a different survey question probed students about whether or not there had been a change in the scope and importance of their job responsibilities. Of the 114 students responding, 67 of them (58.8%) said that their present job responsibilities were either more or a lot more than they had been prior their attending the program. Twenty five of them (21.9%) said that their jobs had a lot more scope and importance than they did prior to their attending GTP.

D. Building an Informal Network of Professional Colleagues

IBM's primary motivation for developing the Graduate Telecommunications Program was based upon its need to have a well-educated group of professionals who would be instrumental in the development and management of its telecommunication networks. However, a number of questions in the survey highlight the fact that a different sort of network, a personal one, has also been formed by GTP.

It was asserted in one of the survey questions that students probably did not know some of the other students who were in their GTP classes prior to attending the program. When asked with how many they had stayed in touch since attending GTP, 58 (50.9%) said that they had stayed in touch with 2 to 4 of their classmates; 35 (30.7%) said that they had been in touch with 5 to 9 classmates; and, 3 (2.6%) said that they have stayed in touch with more than 9 other students in their class.

Fifty-four of the students (47.4%) said that their contacts have been primarily for business, 8 (7.0%) said that the contacts have been primarily social, and 42 (36.8%) said that their contacts have been both business related and social.

Students have also turned to each other for advice after their formal GTP sessions had ended. Eighty-one (71.1%) of the students have contacted another student for advice, and 75 (65.8%) of them have been contacted by one of their classmates for advice.

When asked "How beneficial have the relationships you developed with classmates been since attending GTP?", approximately half the students, 52 (45.6%) said that the relationships were somewhat beneficial. Twenty-five (21.9%) of the students said that the relationships were very beneficial. Eight (7.0%) of the students said that for them, the relationships were the most beneficial aspect of GTP.

E. Continuing Formal Education

An interesting unanticipated outcome of the GTP program has been the large number of students who have chosen to continue their education after graduating from GTP. Of 114 students responding, 65 (57.0%) of them stated that they are continuing their education in either telecommunications or a related field. Sixty-one (53.5%) report that they are enrolled in a degree program. As might be expected, of that number, forty, or almost two-thirds, are working towards a Master of Science in Telecommunications. Ten of them are pursuing a Master of Science in Information Systems, and the others are working towards other Masters or Bachelors degrees. It is also interesting to note that 13 GTP students have completed their degrees since graduation from the GTP program. Eleven of them now have a Master of Science in Telecommunications degree from Pace University.

F. Additional Comments

Student were asked if they had any additional comments to make about GTP. Here is what some of them had to say:

The program was extremely valuable. I have sent two people from my department since I attended and would recommend the program to anyone in telecommunications. The company will greatly benefit from continuing the program.

GTP was a fantastic educational and personal experience. I've also made many good friends as well as business contacts. This was one of the best courses that I have ever attended which was beneficial to me in my career as well as in my own personal development.

Excellent program, which I have seen revitalize both my own and others' careers.

The overall benefit of the program is greater than the benefit of any individual part. My evaluation of the overall program is, and will always be, VERY HIGH. I do not have specific technical responsibilities in my current job. However, the telecom background of GTP4 is invaluable in my area of IBM-Latin America business.

The knowledge gained has helped me in my job, since now I have responsibilities for five additional projects that are in many different areas. The classes have helped me to be better prepared for the variety of problems that come up.

The knowledge gained from GTP has truly increased my comfort level in dealing with other TC technical professionals. Since leaving GTP, I have changed jobs, and in each instance, GTP was referenced as good background in the absence of a specific experience.

GTP was of benefit to me in doing my job. It gave me a broader telecom background. I also attended the summer 2-week classes given at Pace, and I thought that these classes were extremely useful. Overall, I think that GTP was a good experience. It taught me about other areas of telecom, and since then, I have had to use that knowledge.

I found GTP to be a very positive and enriching experience. Telecommunications and networking continue to become more and more important to IBM and the industry. In today's complex world of data networking, it is impossible to get the required skills through on- the-job training.

I think GTP is an outstanding program. I would recommend it to most all the professionals I work with.

GTP provides a very important role in developing the technical, interpersonal and overall endurance skills in effectively contributing to job related responsibilities within IBM.

Conclusions and Implications

It is clear from the findings of the survey that GTP is providing several very positive and long term benefits for IBM. Students view GTP as a highly significant shared experience that will enhance their value to the company. Students leave the program with improved self esteem and sense of professionalism. The fact that most graduates have forged ongoing collegial relationships with their classmates promotes the informal sharing of knowledge and resources without going through a traditional departmental hierarchy. Moreover, GTP has broadened the discipline base of its students, permitting them to perform better on a wider variety of assignments than they were able to do before attending the program.

The broader payoff to IBM for sponsoring a program such as GTP is now becoming clear. GTP is providing (1) significant technology vitality to its telecommunications professionals, and (2) is fostering a climate of professionalism and career orientation that makes its telecommunications function more flexible and adaptive in an ever changing business environment.

The authors feel that programs, such as GTP, can serve as powerful change agents. The ability and willingness of GTP graduates to communicate freely across traditional technical and organizational boundaries leads to better and more creative problem solving. Experiences such as the "Cases in Telecommunications" course allow students to practice team-building skills in a non-threatening setting. The focus is on how to get the job done, and not how to protect one's territory. One graduate aptly summed up this idea as follows:

Since graduating from GTP, it has become increasingly clear to me that a provincial view of one's job is in the long run dysfunctional to the company as a whole.

This survey indicates that much is to be gained through collaborative corporate-university programs such as GTP. Meanwhile, GTP continues on with no end in sight.

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Paper (W2-06)
Telecommunications Projects in European Secondary Schools

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Abstract

This report summaries a recently completed study of telecommunications use in secondary schools in Europe. Over 60 projects were examined and surveys and interviews with project leaders and other educators involved in telecommunications use with secondary school students were conducted and anayzed. An extensive literature and project-report review, conducted on a world-wide basis, provided a framework for looking at the European activity. In this paper we summarize the results of the study with respect to major trends in the instructional use of telecommunications in European secondary schools. We also summarize reccomendations pertinent not only for Europe but also more broadly, for teacher support and, more generally, for telecommunications activities in secondary schools.

Introduction

There is considerable interest, and some controversy, about the place of telecommunications in official policy with respect to computer use in secondary schools in The Netherlands. On one hand, many different projects involving telecommunications use in Dutch secondary schools are in progress or recently completed (Veen, Bakker, & Baak, 1991), paralleled by extensive activity in many other European countries (Commission of the European Communities, 1990) and of course, in North America, Australia, and many other countries and regions. However, policy makers are under considerable pressure to support and stimulate many different aspects of information technology in schools, and in The Netherlands, as well as in a number of other countries or regions are (quite reasonably) asking, "Where should the priorities be?", "What are the results so far of telecommunications projects in secondary school?", "To what extent should we support these projects in the future?"

In this context and to help policy makers and planners address these questions, two studies were commissioned in 1990 in The Netherlands. One, sponsored by the National Curriculum Center, asked for a world-wide summary of strategies for the support of effective use of telecommunications in secondary schools (see Collis, 1992a,b, for summaries of this study. Also, see a summary of this research in Collis & de Vries, 1991). The other study was commissioned to focus specifically on European experiences with telecommunications use for instructional purposes in secondary schools (Collis & de Vries, 1991). The purposes of the second study were to make and analyze an inventory of European experiences with these types of telecommunications projects, and from this to suggest recommendations for policy and further activity in The Netherlands.

The purpose of this paper is to summarize the results of this inventory and analysis. As part of this analysis, similarities and differences between European-based telecommunications projects and North American projects will also be discussed. A brief summary of the general recommendations, applicable outside the Netherlands, will also be given.

Methodology for the Inventory of Experiences

The survey. One source of the experiences summarized in this section was a survey developed for this research. An instrument was developed, consisting of six parts: demographic information, specifics of the respondent's experience with telecommunications use, (personal and for instructional purposes), opinions about the value of telecommunications use in education, appraisal of problems and strategies for coping with the problems, and opinions about the relative priority telecommunications support should be given in the school. A selection of the some of the items from the 14-page questionnaire is given in Appendix A. Dutch- and English-language versions of the questionnaire were prepared.

The instrument was pilot-tested, amended, and then sent to 191 persons from 14 European countries. All of these persons were well informed about or active with telecommunications projects in European secondary schools, with 80% of them project leaders of such projects. The English version of the survey was sent to 54 persons (all outside The Netherlands). The names were obtained through previous contacts of the researchers, participant lists of European-community sponsored seminars on telecommunications in secondary schools (Commission of the European Communities, 1990), and through making an increasing radius of enquiries, including persons who had been involved in the First International Symposium on Telecommunications in Education (sponsored by ISTE and held in Israel in 1989).

The mailing list for the Dutch-language version of the survey was sent to project leaders of national telecommunications projects (known personally to the researchers or through participation in a national congress on educational telecommunications use, held in January 1991.) Also, in the Netherlands, the survey was sent to persons known to be active in policy initiatives or support services (such as developers of curriculum materials) for telecommunications applications in secondary schools. Thus our sample was not representative but highly informed; we wanted to get the most experienced comment we could get about what was happening with telecommunications in European secondary schools. Table 1 summarizes the respondents; in Appendix A (Part I) further information can be found about the types of institutions in which the respondents' work and their job definitions.

Table 1
Survey Respondents, by Country

Country	*Number Sent*	*Received*
Netherlands	137	65
Denmark	15	6
Spain	8	7
Belgium	8	4
UK	7	6
Sweden	6	1
Germany	2	1
Finland	1	1
Israel	1	1
Italy	1	1
Austria	2	0
France	1	0
Portugal	1	0
Greece	1	0

Other sources of information. Other sources of input for the inventories and the conclusions throughout the report included:

1. A review of literature and project reports, mostly of secondary school telecommunications projects with international aspects, based on a collection of over 400 documents and studies, all dating from the 1988 or more recently.
2. The personal experiences and contacts of the authors.
3. Formal interviews with 10 persons in The Netherlands with experience as school project leaders in telecommunications use in general secondary education.
4. Printed information about more than 60 European (not based in The Netherlands) projects and more than 15 Netherlands-based projects. It is difficult to give specific numbers, as many projects have subprojects, which also issue independent reports, and also because it is sometimes problematical to know if an on-going service, such as a bulletin board available to students in a number of countries, should be included as a "project" or not. Our basic criteria were that we tried to consider only telecommunications activities being used for instructional purposes during the normal school day by students in European secondary schools. We made particular use of information from 32 networks or projects active in Europe (see a list in Appendix B for a sample of these) and to a lesser degree, from 31 other European projects. We categorized these as (a) services available for cost to subscribers, (b) networks organized for on-going access by schools or educators, (c) "umbrella" projects with structured activities, and (d) specific-focus, limited-time projects.
5. Notes and materials from a Dutch (1991) and three international conferences (1989, 1990, and 1990) focused specifically in telecommunications projects in schools.
6. Written summaries and reflections prepared expressly for the study by two persons with extensive involvement in telecommunications projects in Dutch secondary schools.
7. A case study prepared expressly for the study relating to the experiences of secondary school teachers attempting to explore the applications of telecommunication within their teaching.

All of these sources are more fully described and summarized in the (English-language) project report (Collis & de Vries, 1991, 270 pp.). Highlights of the summaries will now be given here.

Summary of Results

European Experiences with Telecommunications in Secondary Education

Responses to the survey. Portions of the survey responses to fixed-alternative questions appear in Appendix A. Many of these asked for open-ended responses, all of which have been analyzed and synthesized. Highlights of these responses are that:

1. Most of the respondents (75%) are users of electronic mail, 63% are users of bulletin boards with educational purposes, and 70% make use of on-line information services. So, as we expected, ours was a knowledgeable sample. (See Item 1 in Appendix A).
2. When asked to comment about the overall benefits of telecommunications in secondary schools, the respondents did not see telecommunications as necessarily leading to greater productivity in the school, at least in terms of some of the traditional understandings of this word—reducing costs and increasing administrative communication. (see Appendix A, Item 7). However, the majority (82 out of 93), felt e-mail e-mail to have useful or very intersting educational possibilities; 62 felt the same about bulletin board

applications; and 72 about on-line information sources (Item 4 in Appendix A).

3. We asked the respondents to comment on the experiences they had personally had as classroom teachers implementing telecommunications activities with their own students. The number of respondents in this category was smaller than the total number of respondents (44 out of 93); Items 2 and 3 in Appendix A summarize some of their experiences. Of these classroom teachers, 27 had used electronic mail (CMC) as an instructional project with their students, 9 had made use of computer bulletin boards with their students, and 8 had been involved in on-information projects. There was no real pattern with respect to who sponsored the different projects; but it did matter that apparently all the projects operated on special funding from outside the normal school budgets. With respect to the subject areas in which the telecommunications activities were embedded, The majority of the activities were language-related, or geography, or related to computer (information technology) literacy. No real conclusion could be made about the time involved with telecommunications activities, as so many of the activities occurred in the framework of large-scale, on-going projects with multiple activities. Trying to isolate how much time the teachers spent on preparing for telecommunications use was not possible.
4. Item 3 in Appendix A summarizes the problems faced by the respondents from their experience with telecommunications projects in secondary schools. We can see that, for this group, the most serious problems involved finding financial and personal support within the school and finding a manner to demonstrate the educational payoff of their activities.
5. Item 5 in Appendix A summarizes the responses to the request that respondents comment on the general problems facing the spread of telecommunications use in secondary schools. Problems related to costs, to finding adequate time for teachers and students to make use of the telecommunications medium, and of finding appropriate lesson integration strategies are seen as being of a serious nature by many of the respondents (59%, 51%, 69%, 61%, respectively). Frequently, however, the respondents felt, however, that the problems that are serious now could be reduced in their impact in the future if more means were available for the support of telecommunications activities.
6. The respondents were asked to consider various possibilities for the support of teachers wishing to make use of telecommunications. Item 6 of Appendix A shows the responses. Respondents felt all the suggested alternatives were important. There was particular agreement on the value of organizing inservice that focuses on instructional strategies for telecommunications use and, closely behind this, inservice that helps teachers improve their technical familiarity. Providing on-going support was seen as important, as was ensuring that schools acquire adequate equipment. The suggestion to which the most mixed reaction came related to the sponsoring of teachers' conferences or meetings relative to the topic. There was also difference of opinion relative to the value of establishing a teacher in the school to be a "telecommunications reference person", or of establishing regional or national "help centers". In each case, about half of the respondents felt the strategy was important but the other half varied in its opinion.
7. Finally, respondents were asked to what extent they thought government policy should support telecommunications use in secondary schools. The majority of the respondents (72%) felt that "telecommunications is important enough to invest in at the national level".

As this sample was biased from the start toward those who already were active in telecommunications projects in secondary schools, these survey results should not be overinterpreted. However, they do confirm the North American experience (Collis, 1992a,b) that, even knowing the current difficulties and limitations, those educators who get involved in telecommunications project believe the projects to be significant and to deserve national-level support.

Summary and overall impressions.. There is no tabular way to show how we identified "trends" as emerging from our wealth of qualitative and attitudinal data. Based on our own close analysis of all of our different sources of information, we feel confident that we can say that the following overall observations emerged from our analysis of the European activity with telecommunications use in secondary school:

1. Among those involved in it, there is strong enthusiasm for telecommunications-related educational activity, particularly for CMC; however, there is little evidence of telecommunications use spreading beyond the project boundaries.
2. Almost all the projects are internationally oriented, and have as a major motivation the development of better social understanding and communication skills among students in different cultures. Second-language practice, and anticipation of a post-1992 "common Europe" motivate many of the projects.
3. Almost all European projects are computer-mediated-communication (CMC) activities rather than projects involving access of on-line data bases (exceptions occur, particularly in The Netherlands and the UK) or exchange of scientific data among students.
4. Most project leaders strongly emphasize the need for good instructional preparation prior to and concurrent with the telecommunications activities.
5. The many different projects and activities do not have ways, either technically or through other methods of information exchange, of communicating with each other. Being active in one network or project does not bring any greater chance of getting involved in another network or project. Each one has its own organization and technical require-

ments. It is difficult to get information about projects that are available if one is outside the "mailing list" of the project or service. There is certainly nothing like a systematic synthesis of experiences occurring among the projects (or even within many of them) that can be available to those considering involvement in projects in the future.

6. With the exception of a few of the large projects and services, most of the projects seemed based on or at least strongly fueled by the efforts and vision of one or two key persons. If this person is not able to continue, or when project funding stops, the telecommunications activity also stops. Finding money for international activities, such as bringing participating teachers together for face-to-face planning, is a continual challenge to the projects.
7. Measurement and validation of educational effectiveness is apparently very difficult to carry out, as it is not being done in any systematic way in the great majority of the situations. "Doing the activity," and showing signs of "greater awareness" or "increased motivation" are the most frequently cited "results".
8. Certain problems reappear in most projects and can be predicted as "first-order" obstacles. Unless they are solved, no telecommunications use develops.
9. Once "first-order" obstacles are dealt with, less-tangible "second-order" problems also critically affect the process of telecommunications use. The same clusters of second-order problems appear in study after study and involve pedagogical and organizational issues.

These trends correspond closely to the findings of the more-internationally based literature study (Collis, 1992a, b). The "first-order" and "second-order" obstacles common at both the European and more international level are particularly interesting, and thus will next be described in more detail.

First-level problems. We identified the following list of "first-level" problems that consistently and seriously trouble school telecommunication projects:

1. Unavailable or unusable equipment (modem, telephone connection, telecommunications software).
2. Unknown or difficult or too-costly network connections.
3. Inability of students to have access to the equipment for instructional purposes even if the equipment is available in the school.
4. Inability of teachers to have access to the equipment for familiarization and instructional preparation.
5. Not enough time during regular class periods and within the curriculum for telecommunications activities.
6. Not enough time for the teacher for skill development and lesson preparation.
7. Limited technical familiarity of teachers with telecommunications.
8. Limited relevance with respect to curriculum.
9. Limited awareness by teachers of strategies for instructional management.
10. Time and financial costs.
11. Not enough on-site support and technical help.
12. Not enough evidence of educational value.

Second-level problems. Even after these "first-level" problems are addressed, there arise more subtle difficulties. The outcome of computer-mediated communication, for example, depends heavily on the organizational and pedagogical insight of the teachers involved. Effective use of an on-line information source requires the searcher have well-developed inquiry skills prior to any computer use. (A more detailed discussion of these "subtle" second-order problems associated with CMC use and with on-line inquiry appears in Collis, 1992a, b)

Teacher support for dealing with the problems. Many different strategies are being used to better support teachers attempting, despite all the above problems, to use telecommunications as an instructional tool. Promising strategies include: providing teachers with models and lesson ideas where telecommunications is integrated; improving teacher inservice and on-going support with respect to telecommunications use; improving the design of the software used for the telecommunications activities; and developing simulation software and other preparatory activities that can give teachers and students hands-on familiarization with the "look and feel" of telecommunications use before actually attempting the use. It is our impression that there is more attention being given to improvements in the telecommunications software, its user interface and functional characteristics, in Europe and particularly The Netherlands, than is the case in North America.

Europeans have much less of a pattern of teachers' conferences and regional meetings than do North American and Australian teachers, so there was difference of opinion between the European study and the more international study on the value of these sorts of activities as implementation support for teachers. However, in most other aspects, teacher support recommendations were fundamentally the same in Europe as elsewhere—teachers need on-going support, time, instructional guidance, and support materials if they are to make use of telecommunications in the context of the secondary school curriculum. And, of course, first-order problems of access to equipment, telephone lines, and networks must be handled for the teacher before anything else can occur.

Reflections on European Activity with Telecommunications in Secondary Education

In general, the activity in Europe with respect to telecommunications in secondary education is similar in characteristics to other international experiences. There are some differences in orientation. In particular in Europe, there is less access of on-line collections of information than is the case in North America and more emphasis on non-mother-tongue language practice. The richness of the cultural and language diversity in Europe, within a shared "Europe after 1992" framework, make European secondary schools an excellent base for CMC activities at the secondary school level. However, the language and cultural "richness" of Europe also limits the possibilities of shared use of on-line information sources outside the national level—or unless students are able to work in a second language. Language skill and understanding, however, are at a much more demanding level when attempting to access an on-line information source than when communicating via electronic mail with other students. When added to the complexities of formulating appropriate questions when accessing a on-line information source (see Collis, 1992a, b) it is probably unrealistic to expect much large-scale, European-level use of informational data bases in secondary schools in the near future.

Recommendations

Based on the study, we elaborated two "scenarios" for telecommunications use in secondary schools—one focused on CMC ("The Global Community") and the other on utilization of on-line information sources ("The Information Society"). We recognize, of course, that a optimally profitable scenario will involve both focuses. We then developed detailed projections of the sorts of support, teacher training, policy, and guidance that each scenario could most benefit from over a five-year period. From these scenarios and projections we made recommendations that can be clustered under the following headings:

1. Establish a strategy for the continual consolidation, evaluation, and dissemination of experiences from the many projects and activities going on in the schools in the region or country. Better communication among projects needs to occur.
2. Collect and disseminate models of good instructional practice involving telecommunications use in actual school settings. Videotapes of classroom management strategies and ideas for relevant evaluation of student gains from telecommunications activites are particularly needed.
3. Stimulate and support a limited number of locally appropriate projects and research activities. Finding and streamlining a methodology for action and policy research regarding the educational (and cost) effectiveness of telecommunications applications is a priority.
4. Improve access to telecommunications networks and services in and for schools. This ranges from designing and providing more specialized telecommunications software to subsidized rates for school use of real-world information services, and includes recommendations for providing teachers with modems at home for lesson preparation. Dutch idea of providing schools with specialized telecommunications software ("Telelijn") and also simulation software ("Telesim") to provide off-line tutorial practice with the software and including student and teacher print resources is a good example of this recommendation.

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Appendix A
PRINT Survey: Research in the Applications of Telecommunications in European Secondary Education
(Partial Version, with Results)
Survey mailed, 1 February 1991; Results collated April 1991

In the context of providing recommendations for the application of telecommunications in Dutch secondary schools, we request your cooperation in filling in this survey. For the purposes of this survey when we use the word **"telecommunications"** we are limiting ourselves to **computer-based telecommunications ("the process of connecting two or more computers together by telephone or cables so that the computers can exchange information in digital form")** that are feasible for use by students and teachers in present-day Dutch general secondary schools.

Part I: Personal information

Your complete mailing address: (94 respondents; names and addresses available); not all responses total 94 because of occasional missing or multiple responses)

Respondents are from:	
Secondary School	47
Higher Education	20
Ministry/Government	20
Other	6

Your work title or job description:
Respondents can be categorized as:

Teacher/Faculty	41
School Administrator	12
Researcher	3
Ministry	29
Other	8

Part II: Overview of your experience with telecommunications

1. Below we list three typical types of telecommunications applications that secondary school students may encounter. Please put check marks in the cells below that **BEST** describe your experiences with respect to these three categories.

	E-Mail	Bulletin Boards	On-Line InformationSources
Little or no personal experience	25	35	35
Some personal experience	21	18	24
Regular user	66	38	32

2. (For classroom teachers using telecommunications with their own students) In terms of your experience involving students in secondary schools using telecommunications:

Were the students using:	
Electronic mail?	27
Electronic Bulletin Boards?	9
On-line information sources?	8

Was the activity part of a special project of some sort?
= All but one respondent said "yes"

Did the project receive external funding or support?
= All respondents said "yes"

Did the activity occur:	
In the context of a special course on information technology?	2
In a traditional subject area:	
Geography?	12
Language (Mother tongue)?	4
Language (second language)?	13
Other? (Please describe) (generally special projects that did not try to be part of a specific subject area—i.e., a general "getting acquainted' orientation)	16

3. (Again, for classroom teachers who had used telecommunications with their students) What were the ***difficulties you had in*** *organizing the activity (check as many of the following as apply; give a double-check to that were particularly frustrating):*

	Serious	*Some*	*Little or None*
Finding out about appropriate opportunities to use telecommunications	1	25	18
Getting support in the school to do the activity	13	6	13
Getting access to functioning equipment for yourself (for preparation)	4	14	16
Obtaining the technical skills necessary:			
• how to use the software and hardware,	1	18	13
• how to get on the desired system,	2	18	12
• how to handle predictable problems while using the system	3	16	14
Arranging access to functioning equipment for the students	3	11	15
Helping students to have appropriate technical skills to do the activity :			
• how to use the software and hardware,	1	9	18
• how to get on the desired system,	2	12	16
• how to handle predictable problems while using the system	1	13	10
Finding time to plan for the activity	3	12	17
Finding time for the students to do the activity	3	19	10
Finding a way to evaluate the educational value of the activity	8	12	7

5. (For all respondents) What do you feel are the **major problems** that limit the educational use of telecommunications in secondary schools?

	Serious problem not not likely to be reduced	*Serious problem, but could be reduced with more resources*	*Not a major problem*	*No Opinion*
Availability of equipment	4	63	24	1
Access of students to equipment	6	54	27	1
Access of teachers to equipment for preparation	3	54	31	1
Time available for students	14	33	38	3
Time available for teachers	16	48	22	5
Technical skill needed to use e-mail	9	38	42	0
Use of the software	6	30	50	2
Integration into lessons for educational purposes	14	43	28	5
Finding appropriate partners with whom the students can communicate	8	20	53	10
Costs: Acquisition	10	56	18	4
Usage	18	41	23	4
Personnel	15	41	26	6

6. (For all respondents) How valuable do you think each of the following would be for secondary school teachers who would like their students to use telecommunications for an educational activity?

	First priority	*Second priority, if important funding allows*	*Not so important*
Providing schools with a modem and appropriate software	66	22	4
Organizing courses for teachers on how to use telecommunications from a technical perspective	64	14	13

Organizing courses for teachers on how to develop instructional strategies for the use of telecommunications	67	13	10
Developing specialized software to make telecommunications use easier	63	13	12
Developing specialized resources (i.e., bulletin boards and on-line information sources for students)	49	29	10
Stimulating student participation in international projects involving telecommunications	50	29	10
Setting up a "resource centre" for teachers	47	24	20
Providing a way for teachers to get technical help when they need it	63	21	5
Sponsoring meetings, conferences, etc., for teachersrs	34	39	15

7. (For all respondents) How valuable do you think telecommunications is for the following purposes?

	Very	*Moderately*	*Little*
Reducing costs	27	15	43
Aiding administration	20	42	25
Facilitating exchange of ideas among teachers	44	39	9
Giving students opportunities to interact with students from other cultures	53	32	8
Bringing new possibilities to the classroom	55	33	3
Giving students awareness of information technology	55	29	7

(Excerpts from Survey responses. Open-ended questions also included and responses categorized and analyzed).

Appendix B
Names of Selected European Projects Involving Instructional Use of Telecommunications in the Secondary School and Investigated in This Study

- Apple Global Educational Network (European sites)
- AT&T Learning Network (European sites)
- British Library Project
- Campus 2000 Education Network
- Computer Pals Network (European sites)
- Computer Journal
- DATEM Project
- Denmark-to-France E-Mail Project
- ECCLES
- E-Mail Project Netherlands-France
- European Awareness Project
- European Schools Project
- European Studies Project, Scheme I
- European Studies Project, Scheme II
- Extended Classroom Project
- GEONLINE (Geography On-Line)
- GISET (Geographical Information System for Educational Applications)
- Global Educational Telecommunications Network (European sites)
- International Educational Telecommunications Project (European sites)
- Kalmar Project
- PLUTO International Network Project
- Proefschool Nieuwe Media (Experimental School for New Media)
- PTT-NIVO Project
- RAPPI (European sites)
- Schoollink (European sites)
- Telematica (projects as part of the Dutch "Technology-Enriched Schools" project)
- TENS
- Videotex in education

(Contact addresses for these and other projects are available from the authors.)

Special Presentation–IEEE (W2-07)

The Teaching and Understanding of Computers at the Pre–College Level

Abstract

This panel session will follow a tutorial given by the panelists earlier in the week on the same subject. It is meant to be a debrief of that session, and to provide a forum for discussion on how to better inform teachers of the operation of computers, and how to better use the computer in the classroom to enhance interest and instruction.

Panelists:

Ez Nahouraii
IBM
San Jose, California

Michael Mulder
University of Southwestern Louisiana
Lafayette, Louisiana

Steve Landry
IEEE Computer Society
Lafayette, Louisiana

Bradd Clark
American Mathematics Society

Yale Patt
IEEE Computer Society

Projects (W2-08)
Approaches to Problem Solving

Logo Investigations of Artificial Intelligence

Stephen Sesko, Ernest Franic, Alexander Gonzales, and Matthew Patton
Lawrence Livermore National Laboratory
Berkeley, California

Abstract

Team Logo is a group of selected students in grades four through eleven who are proficient in Logo programming, and motivated in learning. These girls and boys meet for three weeks during the summer to study challenging and complex ideas in mathematics and science with staff members from the Lawrence Livermore National Laboratory. In the past six years, the group has used Logo to investigate Fibonacci numbers, trigonometry, fractals, chaos, and the four forces of physics. Recently, Team Logo has been working with concepts related to artificial intelligence–the subject of this proposal.

This project in curriculum development was designed by Sesko, a computer education specialist, and Minichino, a physicist, in 1989. The project is implemented in a cooperative learning environment, where students and mentors study and learn together, sharing information and solving problems. The presenters will provide detail on the Team Logo project in general, and will demonstrate some of the student–authored programs from their study of AI: Patton will discuss his work with procedures that pluralize words and simple sentences; Gonzales will demonstrate a simulation of an artificial neural network; Franic will show work that demonstrates the strengthening of neural connections on a biological level. Time permitting, Franic will also demonstrate a Logo version of the classic "Block World" problem.

Fairy Tales 1990's Style

Sharon Shrout
Louisville, Kentucky

Abstract

"Once upon a time the language arts and mathematics teachers joined forces to creatively teach 150 seventh graders...," begins the tale at an inner-city middle school in Louisville, Kentucky. *Fairy Tales 1990's Style* was designed to improve students' writing and problem solving skills, to familiarize students with the capabilities of modern technology, and to raise their self-esteem. The project began when students reviewed classic fairy tales and then wrote updated, modern renditions reflecting current societal and personal values. Writing was completed in the school's computer lab. Editing sessions blossomed as the desire to be published made students more receptive to revising their work. Students' diligent efforts were rewarded with the publication of their stories. Students further promoted creative communication skills and cooperative team work as they translated the published stories into video-taped dramas. Drawing on the interdisciplinary nature of this project, students used the stories written in Language Arts class to generate challenging mathematical problems. These story problems were published as a class workbook. As math anxieties decreased in the lighthearted context of the fairy tales, students sharpened their problem analysis and solving techniques. Throughout "Fairy Tales 1990's Style" students' self-esteem soared as they became skilled problem solvers, "published" writers, experienced actors and actresses, and knowledgeable technology users — a real tale of success that resulted from the infusion of technology!

Structured Information System Design: New Direction for Computer Science Curriculum

Betsy Frederick
Albuquerque, New Mexico

Abstract

The Information Systems Design group at Sandia National Labs has pioneered the application of the Nijssen Information Analysis Method (NIAM) in the United States. In the summers of 1990 and 1991, high school students learned and applied the methodology during a three week intensive course. This presentation will describe the high school summer course and plans to extend its reach to year round classrooms throughout the state.

Structured Information System Design is used to analyze a wide range of information systems and adheres to accepted business practices. The methodology is based on simple English sentences to communicate the facts and rules of information systems. This characteristic makes it well within the reach of average motivated high school students. If classroom projects are linked to information analysis needs within the students' communities, students can do useful analysis first as interns and later as part time employees of local businesses.

The Effects of Teacher/Student Interactions On Problem-Solving Skills Development

Jenifer Hartman, Mary Marth, and Judy McLane
Ladue School District
St. Louis, Missouri

Abstract

An action research project was conducted with third graders in St. Louis, Missouri that examined how teacher's responses to students' questions effected the development of problem-solving skills. In conducting the project Teachers Marth, McLane, and Hartman identified three different instructional-assistance strategies to be used with three different groups of children for programming assignments (LogoWriter). Each student group consistently received the same assistance strategy for a period of several months. Various types of data were collected to observe the effects of the different strategies on both student confidence and skill development. The research procedures will be described, the findings summarized, and resulting changes in teaching behavior presented.

Projects (W2-09)
Technology Training for Special Educators

Integrating Computers into a Communication Disorders Curriculum

Paula S. Cochran
Northeast Missouri State University
Kirksville, Missouri

Abstract

In a 1983 issue of *The Computing Teacher*, Glen Bull published an article entitled "Special Training for Special Technology: A Curriculum Use of Microcomputer-Based Tools in Speech-Language Pathology" (Bull, 1983). At a time when many leaders in technology education were focusing on whether or not teachers and clinicians should be taught "programming" and which language was the "best" for educators (BASIC, Logo, Pilot), Bull was looking at such issues with a broader perspective than most.

Envisioning the integration of technology and implementing it, however, are two different tasks. Many university programs in communication disorders are still in the planning stage of how to incorporate computer applications into their curriculum. This presentation will describe one model for facilitating the use and integration of computers in an undergraduate and graduate program in communication disorders. This approach to integrating technology has been successfully implemented at NMSU over the past 4 years, and is based on the following tenents:

- Providing a supportive environment for computer users
- Providing models of appropriate uses of computers with clients
- Recognition of computer usage as a clinical skill
- Providing supervision and consultation as clinical applications are attempted
- Active participation in a professional culture via electronic communication

Similarities and differences between this implementation and the curriculum envisioned by Bull (1983) will be discussed.

Applications of Technology in Training Special Education Teachers

Herbert J. Rieth and Matthew J. Ebeling
Vanderbilt University
Nashville, Tennessee

Prisca R. Moore
Murray State University
Tishomingo, Oklahoma

George J. Haus
Western Michigan University
Kalamazoo, Michigan

Abstract

Reform is the clarion cry in teacher preparation, yet the prevalent response has typically been to increase the length of teacher training programs from four to five years. Additionally, research indicates that formal teacher preparation improves instruction, although little is known about how variations in the ways we train teachers affect their performance. In response to the demand for increased quality in teacher preparation, the need for additional empirical information regarding teacher preparation, and the emergence of many forms of technology as pedagogical tools, the presenters have developed the Peabody Responsive Education Program (PREP), a three stage model which employs microcomputer and multi-media applications to train teachers and teacher trainers to use technology for planning and delivering instruction. The model's conceptual framework,

threestages, and data documenting trainees' use of technology as an instructional tool subsequent to training will be discussed.

The first stage involves training all teacher education trainees to effectively use productivity software and video technology to enhance instruction. The second stage emphasizes enabling teachers and teacher trainees to use technology as an integral part of their ongoing instructional program. The third stage focuses on training teachers to become building/district level technology resource persons and trainers. Training content focuses on instructional design, pedagogical principles, authoring systems applications, multi-media preparation, and advanced productivity tool applications. Computer-based instruction of multimedia applications are employed to model technology applications and to facilitate training to enable teacher trainees to assess student behavior, organize, manage, and deliver instruction, and use technology as an integral part of instruction.

In addition, a microcomputer-based observation system is used to continuously monitor trainees' progress in meeting competencies. The system enables university personnel to observe and record the trainees' behavior in field-based practicum activities. Finally, a computer-based information management system was developed to store data regarding student competency acquisition.

Cooperative Training of Teachers of the Learning Disabled and Visually Handicapped in Special Education Technology

Sandy Parsons, Dennis Cates, and Dean McIntosh
University of South Carolina
Columbia, South Carolina

Abstract

Abstract not available at press time

Projects (W2-11)
Keyboarding–Writing in the Elementary School

Using Technology in the Writing Process: Strategies and Software

Janie Hale
Arlington Independent School District
Arlinton, Texas

Abstract

In the midst of this period of restructuring, teachers cannot ignore the impact of technology on the writing process. It is apparent that computers and word processing must be an integral part of this philosophy. Word processing can be the basis for the marriage of writing and reading in the elementary grades and should, therefore, be the primary focus of computer instruction

Elements of a successful writing lab experience include such essentials as: access time, direct teacher involvement and commitment, technical support, training and a variety of available software. Teaching computers for the sake of learning about computers is not required or necessary at this point.

Keyboarding skills are a genuine concern for teachers and students who are frustrated entering information. Word processing should follow an intensive keyboarding program, so that skills will be reinforced and immediately applied, and techniques for using word processing in the primary grades must be addressed. Young children are able to use computers to write with flexible approaches and appropriate software selection.

Each person plays a vital role in the success of the writing lab including the campus administrator, district computer specialist, classroom teacher and the computer lab manager. Schools measure their success not only by TAAS writing scores but also in school climate as observed in student attitudes and attendance.

When teachers are aware of the power of technology, see methods demonstrated, and are confident about their own abilities, computers are a positive catalyst in the writing process.

Keyboard Hopscotch

Pam Walton and June Ehinger
Sand Springs Public Schools
Sand Springs, Oklahoma

Abstract

Keyboarding is a challenge for anyone to teach, but is becoming more crucial as students use computers. In order to further enhance the concepts of key location and functions, a large keyboard was painted on the walkway near the computer lab. A professional painter was hired through a grant from the Sand Springs Education Foundation. Students could see as well as experience the location of the various keys, offering a different modality to keyboard instruction. The keyboard design, plans and lesson plans and ideas will be presented.

District Implementation of a Keyboarding System That Really Works!

Elizabeth Whitley
Clear Creek Independent School District
Houston, Texas

Abstract

Keyboarding has become a basic skill, beginning with its application at the elementary level. Both the hunt and peck method and the home row method are very frustrating and laborious for our elementary school children and limit their opportunities to complete word processing projects. Because of the pervasive need for this skill today, it is critical that an organized keyboarding program be implemented at the elementary level.

Clear Creek ISD has an excellent plan in operation for teaching keyboarding to intermediate and elementary school students using the Herzog System of Keyboarding.

With the Herzog System, the students:

- Know all the letters on the keyboard in only 2 hours
- Use correct keyboarding techniques
- Are able to compose with the computer in only a couple of hours
- Use Keyboarding for writing skill development

The Herzog System provides that unique factor we teachers need. It makes learning typing fun and easy to manage. Our students are not as conditioned to siting and doing repetitive drills as we were–they expect to see results immediately! And that immediate achievement is what the Herzog System delivers.

It was our District's concern that our students receive the quickest and easiest instruction in the proper way to type and that is why we chose this System. It effectively does away with the home row method; the children learn quickly because it is so logical; the hand positioning device prevents errors; and teachers find it easy to teach.

In the age of computers, no one should be without keyboarding skills. Keyboarding is a literacy basic skill and must be offered to all students.

Our District found the way to easily and quickly implement this important skill and save precious class time!

Getting the Most From Word Processing

Michael Eaton
Carrollton, Texas

Abstract

Abstract not available at press time

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Projects (W2-12)
Logo Applications

Logo and Mathematics: Beyond the NCTM Standards

Gary S. Stager
Fallon Education Center
Wayne, New Jersey

Abstract

This presentation will explore the ways in which Logo supports the NCTM Standards and the exciting ways in which Logo extends the spirit of the standards by creating opportunities for personal construction of mathematical concepts. The Logo philosophy predates the NCTM standards and provides opportunities for students to experiment with mathematics in powerful ways not possible without a computer. The Logo environment provides learners with a fertile laboratory for becoming junior mathematicians.

The session will use LogoWriter, LogoEnsemble, LogoWriter Robotics, and the Phantom Fishtank as vehicles for presenting mathematical concepts and positive mathematical experiences to the majority of learners who haven't been successful under the regime of traditional mathematics instruction. Numerous learner-centered Logo activities will be presented that can be used by students with a wide variety of learning styles and grade levels to not only learn fundamental math concepts, but just as importantly to experience the magic and beauty of mathematics. Logo will be used in this presentation and the accompanying handouts to model innovative mathematics activities through which students may construct important concepts, including: arithmetic, fractions, data analysis/graphing, functions, geometric constructions, probability, measurement, spatial reasoning, decimals, patterns, cellular automata, and experimental math.

Student Projects Using LogoWriter Hypermedia: A New Visual Environment

Eadie Adamson
The Dalton School
New York, New York

Abstract

Today's students have a different orientation to information. No longer are they tied to text as the primary medium of communication. The effects of this upon our approach to education are only beginning to be imagined. LogoWriter contains primitives to program text as well as graphics. A set of Logo-based hypermedia tools to use with LogoWriter has been the basis for hypermedia projects by students across the United States during the past year.

LogoWriter Hypermedia tools allow students to show us what they know, giving us a window into their minds. The textual and visual connections they make afford a new means of "conversation" about what they have learned and how they understand what they know. This conversation can now include text, LogoWriter graphics, animation and sound, as well as scanned images and videodisc sequences. Examples of student work with LogoWriter Hypermedia Tools, with and without use of a videodisc, will be shown.

A Problem-Solving Course for Preservice Teachers: Problem-Solving with LogoWriter

Kathleen Maury
Mankato State University
Mankato, Minnesota

Abstract

The University of Wisconsin-Superior has developed an undergraduate two and a half credit hour course which is required of all preservice teacher preparation students. This presentation will outline in detail the curriculum used in the course, the teaching strategies used, and the student outcomes achieved.

The purpose of this course is threefold. The primary goal is to teach problem solving within the dynamic interactive environment offered by computers. In addition, students become familiar with the mechanics of computer use, become familiar with the LogoWriter software in particular, and learn to think algorithmically using the microcomputer as an interactive tool. Also, students develop the ability to use the LogoWriter environment for their own mathematical problem solving, and the ability to teach mathematics lessons to elementary school aged children using LogoWriter as the tool. In the process of completing course requirements, students develop interactive LogoWriter programs which can later be used with children, parents and others within actual school settings.

Pre-service teachers complete their teacher education program able to use technology within the school setting, use LogoWriter as a mathematics environment, and teach problem solving using the interactive environment of the microcomputer.

Projects (W2-13)
Hypermedia

Maximizing The Discovery Process

Judy Grissom and Zelia Frick
Salisbury, North Carolina

Abstract

Education has always depended on exploratory learning. Now, technology allows educators to extend and enrich this approach. This session will demonstrate the positive impact of multimedia throughout the curriculum, as it brings to the classroom a creative learning environment that allows students to adapt to their ability level.

The classroom of tomorrow will use HyperCard as both an organizational and instructional tool. We will demonstrate how elementary students used the Macintosh, HyperCard, and laserdisc to design original presentations and lessons for their classmates, instead of composing pencil and paper reports. Unlike traditional reports, our students are encouraged to apply higher-order thinking skills by interfacing the media in a non-sequential fashion. Their reports take on new life with the help of on-screen maps and buttons. They take a new interest in research and the writing process when presented with the opportunity to design HyperCard-based interactive facts. Instead of being information gatherers, these students are given the chance to be information manipulators and disseminators. As they design their own stacks, they are forced to decide not only what information to represent, but how to represent it. Our presentation will serve as a catalyst in helping others enrich the learning experience and empower the student.

HyperStory-Personalizing a HyperCard Story for Your Students

Michael Land
Wichita Falls, Texas

Abstract

The presenter will describe and demonstrate a technique whereby teachers or parents can take a story written or presented in HyperCard and personalize it by using the names of students or family members or friends in the story. Once the names have been placed into one hidden field, the names in the story can be changed with the click of a button. Individuals who bring a 3.5 inch disk may have a copy of the stack to use in their own classrooms.

Assessing Student–Produced Hypermedia Projects

Sharon Yoder
University of Oregon
Eugene, Oregon

Abstract

Hypermedia provides both exciting new potential and a whole new set of problems when used in the traditional classroom. Student produced hypermedia is often created in an open environment where the student decides the topic and format of his or her project. These products are often non-sequential in nature.

A teacher can no longer "flip through" the entire product to get an overview. She can't even look at the product without a computer, and perhaps even other technologies as well. How does the teacher know that she has seen everything that the student included? In a non-sequential document, some branches can easily be missed. How does the teacher guide the student to avoid such problems? Teachers expect that traditional projects communicate what the student has learned. However, a poorly designed hypermedia document can be very difficult to untangle. Should the design and linking of a hypermedia product be evaluated?

This presentation will examine

- the establishment of criteria for open-ended assignments in a hypermedia environment,
- setting guidelines for communicating the structure of a hypermedia product, and
- examining and evaluating code associated with a hypermedia product.

Participants will receive handouts and have access to *HyperCard* stacks used in this evaluation process.

Teachers Utilizing Hypermedia to Meet Their Curriculum Needs

Sherah Betts Carr
Trickum Middle School
Lilburn, Georgia

Abstract

Utilizing hypermedia for a staff development research project is the focus of this presentation. Middle school teachers were trained in their local school networked Apple IIGS Lab using the hypermedia authoring system, HyperStudio. By combining text, graphics, scanned images, audio, and laserdisc clips, the teachers designed their own stackware to meet their specific curriculum needs and enhance their interdisciplinary units. After completing the curriculum related stacks, the teachers used this innovative instructional tool to help students conceptualize the various components of their topics. Students, in turn, were intrigued by this new technology and were inspired to start creating their own hypermedia inventions. The project presentation will include actual samples of teacher and student stacks as well as the preliminary results of the data collection from the project. Insights as to teachers' perceptions concerning the use of hypermedia as an instructional tool will be discussed.

Special Window (W3-01)
The Role of Technology in Restructuring

Chris Dede
George Mason University
Washington D.C.

Abstract

Advanced information technology is essential to the success of school restructuring. Individualized learning and decentralized institutional structures require improvisational scheduling, flexible roles, accountability and incentives based on performance , and the distributed coordination of interacting organizational processes. All types of organizations are finding that sophisticated computational and communications capabilities are necessary for orchestrating such complex operational practices.

Imagine that you had the power to completely redesign every learning environment, every instructional situation, every educational organization. This would be a very exciting prospect, because our present schooling system is weighted down by the dead hand of past political compromises, mistaken theories, obsolete approaches, and dysfunctional rituals. The core of developing such a new paradigm for educaiton should be based on insights drawn from the leading edge of practice in cognitive science, management theory, and pedogogy.

Sophisticated information tools are vital to making restructuring work, but most reformers perceive educational technology as peripheral to their goals. Instructional technology will be underfunded and underutilized as long as it is seen as a hood ornament for the classroom rather than a driveshaft that empowers more effective models of teaching and learning. This session will present design and implementation principles for information technology in educational restructuring.

Special Presentation–EDUCOM (W3-02)

K–12 Networking Partnerships with Colleges and Universities: Current Activities and Future Prospects

John Clement
EDUCOM
Washington, D.C.

Abstract

This panel session will highlight three notable partnerships based on an NSF–funded survey project.

ADAPT Spotlight (W3-03)

Whole Life Learning: Natural Print Literacy on the Color Macintosh

William Peet
San Diego, California

Abstract

In this demonstration session, participants will see how the Macintosh LC can be used to set-up a natural series of writing activities that will take any non-reader/writer from zero print literacy to first or second grade abilities. Two exemplary software packages will be used: the new *Dr. Peet's PictureWriter* by Texas Courseware and Interest-Driven Learning, and Great Wave Software's talking word processor, 'Story Writer,' on the *KidsTime* package.

Special Presentation (W3-04)

Transforming Educators: Getting Teachers Involved with Technology

Annette Lamb
University of Toledo
Toledo, Ohio

Stanley Zenor
AECT
Washington, D.C.

Abstract

...My chalkboard works just fine.
...I'm six years from retirement.
...I've seen most of the educational software. It's junk.

These are familiar comments from educators. Regardless of whether they are professors of chemistry or teachers of first graders, many educators are reluctant to embrace computer technology as a tool for instruction. How can we get educators more involved using emerging technologies (e.g., computers) as instructional tools? This session addresses this growing concern. The early innovators are already on the "technology" band wagon. However, what about all the educators in the shadows that aren't making use of what technology has to offer? Hypermedia applications, desktop publishing, desktop presentations and other "high tech" areas are a great way to get educators involved with technology. With the use of easy-to-learn authoring and production tools, educators can develop professional-quality computer-generated materials.

It is our job as technology users to encourage the integration of technology into the curriculum. We often become so entrenched in our daily routines that we forget about the need to reach out to others. This session will provide sneaky and not-so-sneaky ideas for getting teachers involved with technology. It will explore ways to encourage reluctant educators to use tools of technology for personal, professional, and instructional applications. Ideas for teacher-student collaborative projects will be discussed. Finally, the session will highlight strategies for conducting effective teacher inservice and workshops.

Projects (W3-05)
Science and Multimedia

The Florida Science Videodisc Project

Robert Fronk
Florida Institute of Technology
Melbourne, Florida

Abstract

This is an update on the 1992 Florida Science Videodisc Project. The initial 1990 and 1991 projects have received further funding and are being continued into 1992. This year 64 Florida pre-college and college teachers will get together at Florida Institute of Technology in Melbourne to learn about and work with computers and videodiscs. In addition to receiving training in interactive video development in the project's educational technology laboratories, participants will receive a videodisc player, a stipend, videodiscs, computer software, graduate credit, and other materials. The project will create the third "Florida Science Videodisc" with slides and video from the 64 teachers and F.I.T. faculty. The 1992 project will focus on both science and mathematics (previous years' work dealt mainly with the physical and life sciences). The 1992 Florida Science Videodisc will include over 5000 science and mathematics images from the previous projects and from this year's project.

Activity and Technology Oriented Math and Science

Barbara Johnston and Eric Nelson
Southern Humbolt Unified School District
Garberville, California

Abstract

A.T.O.M.S. is a ninth grade curriculum which is part of a district wide project to improve math and science instruction for "at risk" students in a small rural school district. Our goal is to see a greater percentage of these students take upper-level math and science classes and go on to college. To do this we have tapped the wealth of talent and resources of the existing teaching staff and made use of a variety of county and regional resources in carrying out our project plans. We will share the creative use of teacher release time, staff development activities, peer coaching, flexible scheduling, and the way in which we have expanded the role of computers in the education of our "at-risk" students which are all elements of the project.

The Learning Center for Interactive Technology–National Library of Medicine

Victor Carr
National Library of Medicine
Bethesda, Maryland

Abstract

Abstract not available at press time

The TEAMSS Project: Interactive Multimedia for Middle School Science Educators

C. Dianne Martin and Rachelle S. Heller
The George Washington University
Washington, D.C.

Abstract

The two-year TEAMSS Project funded by the National Science Foundation is designed to enhance the content knowledge and teaching skills of middle school science educators, to create a model for the innovative use of computer-aided, hypermedia technology in science classrooms, and to encourage increased collaboration between educators and scientists. The first year focused on the life sciences, and the second year will focus on the physical sciences appropriate for the middle school science curriculum.

Each year fourteen teams, consisting of a science coordinator, a master science teacher and a novice science teacher, from public and independent school systems in the greater Washington, D.C., area are selected to a four-week summer workshop at George Washington University. The workshop features *skill-building* through hands-on instruction in the use of computer-aided hypermedia, *content enhancement* through collaboration with a science specialists, *skill and content utilization* through the integration of the new technical skills and science content into classroom lessons, and *resource identification* of technology resources in the local area. School year follow-up includes a meeting to plan for inservice training conducted by participants, dissemination and implementation of the science lessons, and participation in a regional conference for science educators.

Paper (W3-06)
Introducing Computer Science to Undergraduates

David Cordes
University of Alabama
Tuscaloosa, Alabama

Abstract

What is the best way to introduce Computer Science to incoming students? A number of different plans have been proposed, ranging from the original Curriculum '78 ideals to the ACM Task Force on the Core of Computer Science recommendations. This paper examines the efforts that the University of Alabama has undertaken during the past two years in moving towards a new introductory course sequence, and explores the rationale behind the decisions that were made during this process.

Introduction

For years the fundamental method for introducing Computer Science has been that of programming, programming and more programming. Students took a first-semester course in a language, followed by a second course, followed by more courses in additional languages. It was not until a student's junior or senior year that he/she was introduced to other concepts such as theory, operating systems, or database systems. In fact, most of the professionals in the discipline today probably grew up in such an environment.

The ACM Task Force on the Core of Computer Science (COCS) presented a radical departure from tradition in their 1989 recommendations (Denning *et.al.*, 1989). The introductory sequence they present resembles the pattern that one normally associates with Chemistry or Physics. That is, the initial course(s) provide a broad overview to the discipline as a whole. The Task Force calls for a three-semester, in-depth introduction to the discipline as the first sequence of courses taken by the student. The Task Force makes several basic assertions and assumptions regarding their introductory discipline. That is, students have:

- Programming background in some structured programming language
- Experience with computer-based tools (word processors, spreadsheets)
- An adequate mathematical background (discrete math, calculus)
- Some background in statistics and probability

Since that time, a number of people have argued over the proposal. It has been pointed out that not all schools can guarantee the meeting of the above critéria for its incoming freshman. Additionally, several suggestions and enhancements have been offered regarding the original COCS recommendations.

Pratt (1990) argues that the new approach would "frustrate" more than motivate the student. The student should be exposed to the field, but too long of an introduction will only frustrate those students anxious to get to the actual material. Baldwin (1990) argues that the emphasis should first be placed on algorithms and their construction. The fundamental building blocks should be re-arranged with basic algorithmic knowledge as their base. Locklair (19991) suggests that the current introductory sequences are still too narrow in their viewpoint. Instead, an even broader "big picture" should be introduced. Finally, Motil (1991) believes that the proper introduction is through large, software-engineering type experiences.

Looking at any of these approaches; however, one item becomes clear. Somewhere very early in a student's academic career, he/she should be presented with a basic, fundamental idea of "*what Computer Science really is and what it involves.*" There are two reasons for this. First, it provides a point of reference for guiding the remainder of the student's studies. The student requires this framework if he/she is going to be able to successfully classify and categorize the materials that will be presented over the course of their academic careers. Without a proper framework, the student will fail to grasp the relationships and importance of topics introduced to him/her. Second, it provides an early warning for students who do not really want to major in Computer Science, but have not yet realized this point. The best way to see if a student is truly interested in a subject is to introduce them to the subject. Introducing them early in their career avoids wasting the student's time and efforts.

The University of Alabama has re-structured and re-organized its introductory course sequence in Computer Science. This paper presents the results of this re-working.

The Original Curriculum

The Computer Science undergraduate curriculum at the University of Alabama originally proceeded as illustrated in Figure 1. Essentially, the curriculum was a sequential process for the first two years, with a wide fan-out as the student reached their junior year of studies.

The student took Pascal I, Pascal II, Discrete Math and Assembly Language, and then Data Structures. Data structures was the "departure point" from which the student could pursue any number of advanced courses. This list includes Programming

Languages, Operating Systems, Database, Theory, Systems Programming, Artificial Intelligence, and Software Engineering.

The above curriculum is fairly standard, and similar curricula can be found in a number of other institutions. However, there were three basic areas that it was felt demonstrated the inadequacies of this curriculum.

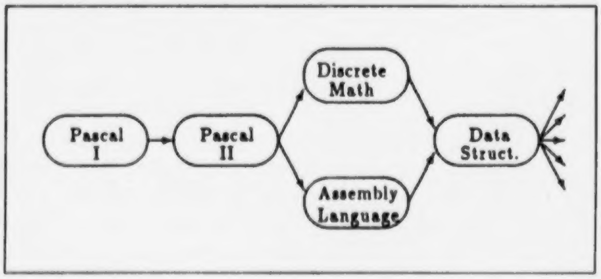

Figure 1

First, the curriculum does not permit the "motivated" student to reach the "meat" of the discipline until their junior year. An interesting observation was that some of the best students in the early (programming) years were complete failures in comprehending the basic principles involving a given subject, such as Artificial Intelligence or Operating Systems. Likewise, some marginal "programmers" performed excellently in the individual fields within the computing discipline.

The second concern centered around the mentality of the students that were showing up in the junior and senior-level classes. These students were "programmers" in the true sense of the word. They were not ready to discuss general design strategies, basic theories of the discipline, or high-level views of the field. Instead, they wanted to concentrate on the implementation of specific examples. The "big picture" did not matter to them, as long as they knew how to implement the bits and pieces.

The final concern regarded the fact that the student was exposed to he 'bulk' of the discipline in their last year of studies. Having no prior introduction to any of these areas, the student was expected to grasp the concepts of Programming Languages, Operating Systems, Databases, Artificial Intelligence, Software Engineering, and other fields within a year to year-and-a-half. Students enrolled in two or more of these classes simultaneously often failed to fully appreciate the foundations and issues involved in the area.

Given this, a new curriculum was developed for the first two years of the undergraduate program. This curriculum is outlined in the next section, along with the rationale for its adoption.

The Revised Curriculum

The revised curriculum is illustrated in Figure 2. The bulk of the modification involves the development of a new course that provides a broad overview of the discipline as a whole, the re-structuring of the pre-requisite chain, and the adoption of formal laboratories for several courses.

Three basic themes governed the adoption of this curriculum. These are:

Expose the student to the breadth of the discipline early in their academic careers. This exposure will illustrate the various fields found within the discipline, yet should not delay the student's entry into courses specifically exploring any one of these subjects. This was accomplished by dropping the 'Programming II' course and replacing with an "Introduction to Computer Science" course.

Place a greater emphasis on structured laboratory components in the introductory courses. Laboratories have been introduced into both the Introduction to Computer Science course and the Assembly Language course.

Permit the student to reach the 'discipline-specific' courses (AI, Software Engineering, Programming Languages, *etc.*) earlier in their studies. The revised curriculum permits students to start taking courses such as Software Engineering, Database, and Artificial Intelligence at the end of their sophomore year.

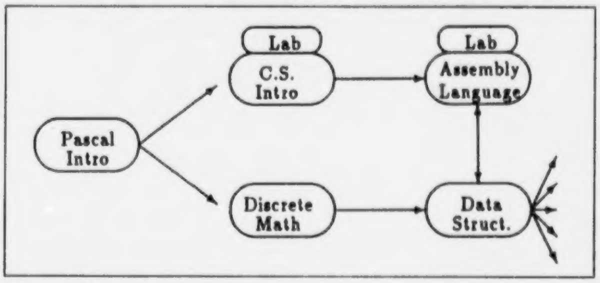

Figure 2

The first course, Introduction to Computer Programming, now covers the entire Pascal programming language. It has been tightened and re-worked as to permit coverage of the entire language within the fifteen week semester time frame. Since Alabama does not offer formal teacher certification in Computer Science, and over sixty percent of our incoming freshman body is from within the state, it is unlikely that we will be able to mark this course as 'remedial' for several years to come.

Once the students have completed this first course, they can then proceed to both the Discrete Math course and the Introduction to Computer Science course. Both of these courses demand basic programming knowledge, but the materials presented within them do not govern establishing one as the prerequisite for the other.

The Introduction to Computer Science course is a five hour (course and lab) sequence. It provides an overview of the discipline as a whole, and will be discussed in greater detail shortly.

Upon completion of these courses, the student is eligible for both the Assembly Language and Data Structures courses. There is minimal justification for demanding an assembly and machine organization course prior to a course in data structures. Given this, the pre-requisite chain was modified, permitting the student to enroll in these courses simultaneously. Furthermore, to enhance the assembly language course, a formal laboratory was developed.

Finally, the Data Structures course still serves as the "departure point" for the remainder of the curriculum. The topics included within this class have now been upgraded (due to the contributions of the Intro to Computer Science course). After mastering the materials presented in Data Structures, the student has the background necessary to take any of the upper-level Computer Science courses.

The Intro to Computer Science Course

The foundation around which the curriculum revision revolved is the "Introduction to Computer Science" course. This course replaces the "Pascal II" course in the original curriculum. The new course is a four-hour course, with an additional one-hour laboratory. The course was intended to:

- Provide a view of the "big picture" of Computer Science
- Introduce basic data structures and algorithms at an early stage

The course assumes that students enrolled in it know a high-level programming language (Pascal). Using this, the student is exposed to the breadth of the discipline, with specific programming examples to illustrate each subject matter. For example, students in the past have developed maze-traversal routines using the basic information they were presented regarding stacks and graph algorithms.

Looking at the course in more detail, the following subjects are presented to the students: Basic algorithm development; Basic data structures (linked lists, stacks, queues, binary trees, and graphs); Searching and sorting (bubble, selection, insertion, heap, quick, merge) techniques; Introduction to programming languages (syntax and semantics, BNF forms, binding and binding times); Bases (ten, two, eight, sixteen); Machine representation of integers, characters and real numbers; Machine organization; Basic machine hardware (and/or/not gates, adder, register, data bus, clock); Introduction to operating systems (concurrency, interrupts, scheduling); Introduction to artificial intelligence (logic programming, expert systems); Introduction to software engineering (life-cycle, software crisis); and Ethics in computing.

The goal of the course is not to ensure competence in each of the areas, but to provide a "feel" for what the area involves. Given that the students are capable of programming, sample exercises can be developed illustrating applications in each of the various areas.

Of paramount concern in the development of this course was ensuring that the course was not a "survey-only, top-level, throwaway" type of course. We wanted to ensure that when a particular area of Computer Science was examined, the details (the "meat") of the area were addressed. A top-level course would be viewed as a lot of hand-waving and fluff. When a topic was discussed, specific examples and algorithms were examined. Since the students were all competent programmers, exercises and laboratory experiments were also possible.

As mentioned above, this course is designed to help the student place the various areas of computing in their proper perspective. The course concentrates on building a skeleton into which the students can place information as they progress through their undergraduate careers. Finally, the course devotes two weeks (the last two weeks of class) to the topic of "Ethics in Computing." The students examine the ACM Code of Professional Conduct, discuss the various ethical issues identified in (Weiss, 1990) and other sources, and generally explore the issue. Since the students have finally been exposed to the various issues associated with a given field of Computer Science, it is possible to start ethics discussions early in their academic career.

At the end of this course, the students should have developed a frame into which they can begin to classify and categorize the information they will learn over the next few years. In addition, their programming skills have been enhanced, using examples that directly relate to the various areas within the discipline.

Conclusions

As is evident from the previous sections, the University of Alabama has drastically altered its introductory sequence in Computer Science. However, the alterations fall short of those recommended by the COCS Committee. The revised curriculum should be viewed as a "bridge" attempting to encompass both the recommendations of the COCS committee and the realities of the environment in which the University operates.

In looking at the background of a given freshman, the vast majority of the students have no prior training in Computer Science. While some high schools in the state do offer course(s) in computing, there is no formal teacher certification in Alabama for Computer Science. As a result, wide-spread knowledge of computing is lacking in the freshman class. A significant number of our students require a full year of math *prior* to enrollment in Calculus.

Given these factors, a course sequence was developed that provided early exposure to the discipline, yet still maintained training in basic programming. Additionally, it could be taken as students were brought 'up to speed' in mathematics. This revised curriculum has been in place for approximately two years. During this time it has undergone minor revisions regarding specific course pre-requisites, but has remained essentially intact. Informal student evaluations seem to indicate that the new curriculum is a much preferred curriculum. In fact, we have had numerous students enrolled in our original curriculum change to the revised curriculum (in spite of having to take courses such as "Intro to Computer Science" at a junior or senior level).

While we are pleased with the results of the revised curriculum, we have not yet accepted it as "optimal." In fact, two major changes are currently taking place within the curriculum. One is the incorporation of a formal laboratory into the Introduction to Computer Programming (first course). Students would be placed in a regular laboratory setting in which they could discuss program development, design, implementation and testing as they related to the specific project at hand. Additionally, students would have immediate help for problems.

The second change is the adoption of a new course into the introductory sequence. This course deals with the introduction of programming tools and techniques. Specifically, topics such as program debugging, program maintenance, design techniques, and documentation (both reading and writing) are addressed. This course is designed to help the students in developing techniques for developing and managing single-person software projects. Emphasis is placed on the ability to utilize existing tools to assist in the development process.

Other changes are also under consideration. Foremost among these is the separation of the Data Structures course into two separate courses, Data Structures and Algorithms. It is felt that students fail to appreciate the significance of proper algorithm design and data structure usage. It is very hard to develop an appreciation early in their career, when the programs are still simplistic and straightforward. Providing an in-depth examination of data structures and algorithms immediately prior to their usage in artificial intelligence, operating systems, *etc.* would benefit the student greatly.

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Paper (W3-06)

A Visual Demonstration of Recursion in Pascal

Dr. Raymond O. Folse
Nicholls State University
Thibodaux, Louisiana

Abstract

Most instructors will admit that one of the more challenging topics to teach students is recursion. Traditionally, at the college level recursion is taught at the end of a first course in computer science. I suspect that this is also the case at the high school level.

Students fear and dread recursion, and even some experienced programmers consider it difficult and avoid it. There are probably several reasons for the unfounded fears.

First, poor results are due to the approach that is used to introduce the concept of recursion. As instructors in computer science courses we are all guilty of applying the textbook method of teaching programming. This approach is also referred to as the static approach [4]. Students are required in this method to read static listings of programs to discover the nature of an algorithm. Because of the implicit role of the run time stack in the recursive solution process, a static approach most often fails to produce total understanding of the concept.

Secondly, because recursion is introduced after iteration it is believed to be more difficult to learn. Some instructors have found more success in teaching recursion by introducing it before iteration [2].

This paper introduces a program developed by the author to dynamically illustrate the actions of recursive solutions to three problems.

Visualization of Programs

There are two separate aspects to every program - static and dynamic [3]. An instructor usually traces the execution of the program in question on an overhead projector or the blackboard. Students in the class take notes on the discussion, which yields a static representation of dynamic concepts.

The growing field of program visualization or visual programming (VP) has evolved in recent years to offer various alternatives to the traditional static approach to teaching computer science. This field's development has been enhanced by the emergence of low cost high quality graphics devices. Capabilities of these systems range over a broad spectrum of possibilities [1].

Some systems have the capability to dynamically represent any program in a particular high level language. These systems are at the upper level in terms of price and sophistication of hardware. At the lower end of the spectrum are programs that demonstrate the execution of particular programs. These systems, which are inexpensive and require only microcomputer compute power, are very useful in class presentations and for self study by students.

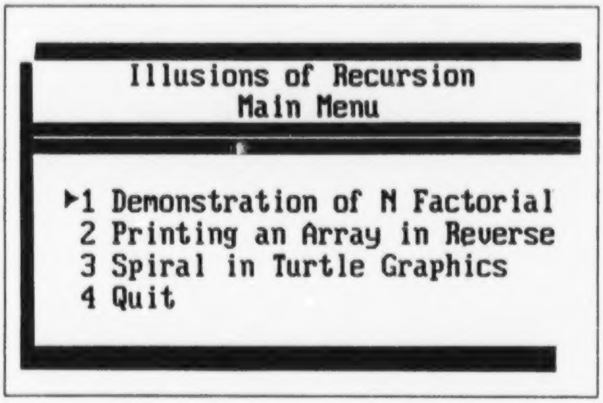
IPLEX1, which is a program with a menu system that references a library of dynamic introductory Pascal programming examples, was developed by Dr. Robert J. McGlinn and others at Southern Illinois University [3]. This program produces dynamic demonstrations of programs that reflect the basic concepts of Pascal. It is an excellent tool for giving the beginning student an idea of what goes on in the execution of a program.

The program developed by the author to dynamically illustrate recursion was influenced by the design of the IPLEX1 system.

Illusions of Recursion

The software system, which is named Illusions of Recursion (IOR), demonstrates the solution of three problems. These include recursive solutions to n factorial, reverse printing of an array and turtle graphics presentation of a spiral. Complete listings of the three programs are found in the papers's appendix.

The main menu of the system is given next.



```
      Illusions of Recursion
            Main Menu

 ▸1 Demonstration of N Factorial
  2 Printing an Array in Reverse
  3 Spiral in Turtle Graphics
  4 Quit
```

Figure 1

In teaching the topic of recursion we point out to our classes that every recursive subprogram in Pascal has two (2) requirements. These include:

1. A recursive component and
2. A base case which terminates the subprograms actions.

The IOR system simulates the action of each step in the program. Memory allocations, Boolean test of variables, arithmetic operations, calls to subprograms and the run time stack are illustrated. When the base case of the algorithm is executed the implicit popping actions of the run time stack are dynamically enacted.

Given below are diagrams of several of the steps in the demonstration of the solution to 3! created by IOR. The first diagram indicates the status of the system after the first call to the function Fact from the main program. The second diagram depicts the status of the system just prior to the execution of the base case. The next several diagrams indicate the dynamic aspects of the stack after the execution of the base case. The last diagram indicates the state of the program after the execution of the main program's last statement.

Conclusion

The current approach to teaching recursion often fails to achieve the necessary level of understanding of the dynamic aspects of such programs. Our good students are usually capable of visualizing the dynamic aspects of recursion. However, the majority of our students need help in understanding what happens during a recursive program. It is felt that the use of visual programs in the computer science classroom will enhance the comprehension of students.

A copy of the IOR system is available from the author upon request. Interested parties should send a diskette to Dr. Raymond O. Folse, Nicholls State University, CMPS Dept.,P.O. Box 2168, Thibodaux,LA 70310.

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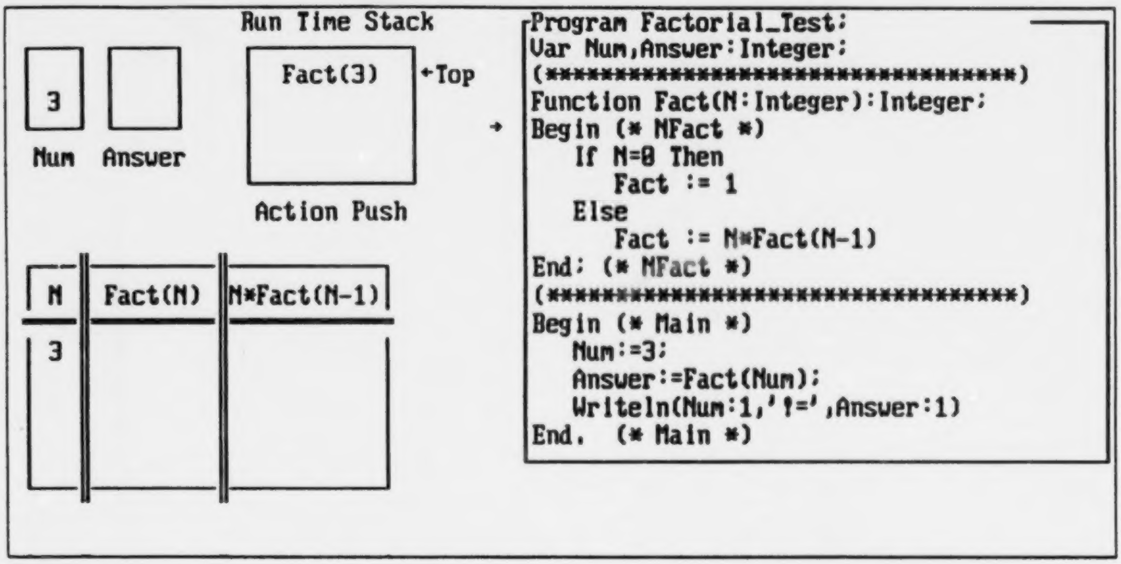
Appendix
Listings of Demonstration Programs

```
Program Factorial_Test;
Var Num,Answer:Integer;
(***********************************)
Function Fact(N:Integer):Integer;
Begin (* NFact *)
If N=0 Then
Fact := 1
Else
Fact := N*Fact(N-1)
End; (* NFact *)
(***********************************)
Begin (* Main *)
Num:=3;
Answer:=Fact(Num);
Writeln(Num:1,'!=',Answer:1)
End. (* Main *)
.pa
```

```
Program Reverse_Print;
Type Vec6=Array[1..6] of Integer;
Const A:Vec6=(3,7,9,13,11,15);
(****************************************)
Procedure R_Print(X:Vec6;First,Last:Integer);
Begin (* R_Print *)
If First <= Last Then
Begin (* Then *)
R_Print(X,First+1,Last);
Write(X[First]:3)
End (* Then *)
End; (* R_Print *)
(****************************************)
Begin (* Main *)
R_Print(A,1,6)
End.
```

```
Program R_Spirals (Input,Output);
(* Turbo 3 users insert (*$I graph.p *) for Uses statement
*)
Uses Graph3,Crt; (* Required in Turbo 4 or greater *)
Var Magnitude,Angle:Integer;
Procedure Spiral(Mag,Turn:Integer);
Begin (* Spiral *)
If Mag > 0 Then
Begin
Spiral(Mag-5,Turn);
TurnLeft(Turn);
Forwd(Mag);
Delay(500);
End
End; (* Spiral *)
Begin (* Main *) Appendix

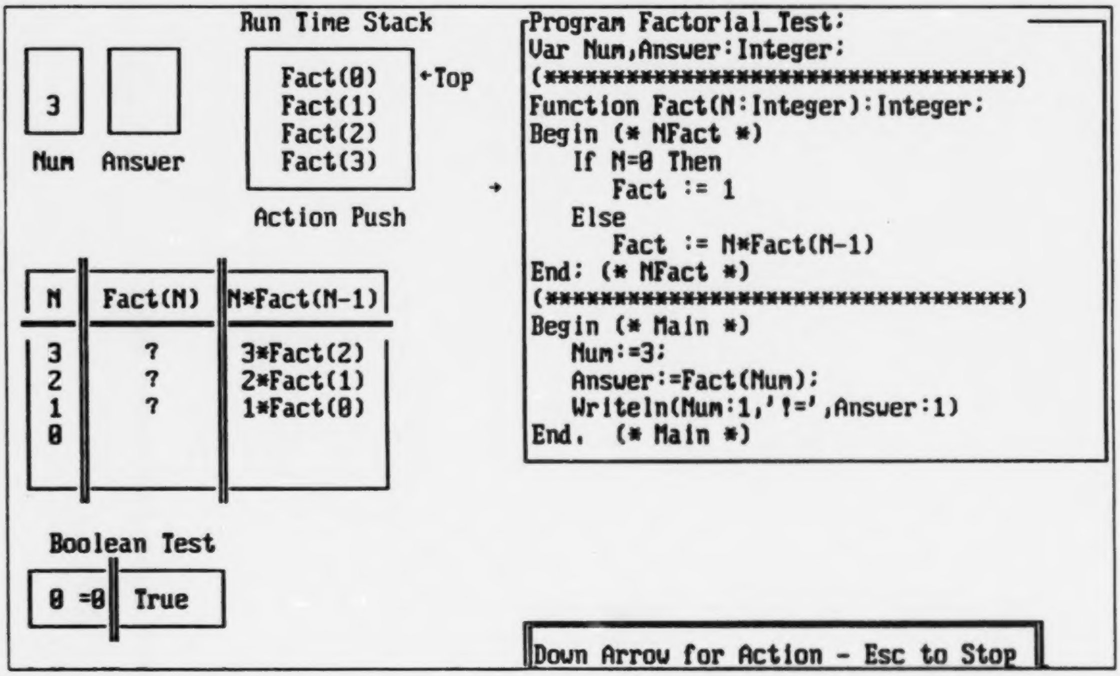
Magnitude:=50; (* set parameters for run *)
Angle:=90;
GraphColorMode;
GraphBackGround(Blue);
Palette(3);
SetPenColor(3);
TurtleWindow(50,50,75,75);
SetHeading(90);
Spiral(Magnitude,Angle);
```


Run Time Stack
Fact(3) ←Top
3
Num
Answer
→
Action Push

N	Fact(N)	N*Fact(N-1)
3		

```
Program Factorial_Test;
Var Num,Answer:Integer;
(**********************************)
Function Fact(N:Integer):Integer;
Begin (* NFact *)
   If N=0 Then
      Fact := 1
   Else
      Fact := N*Fact(N-1)
End; (* NFact *)
(**********************************)
Begin (* Main *)
   Num:=3;
   Answer:=Fact(Num);
   Writeln(Num:1,'!=',Answer:1)
End.  (* Main *)
```

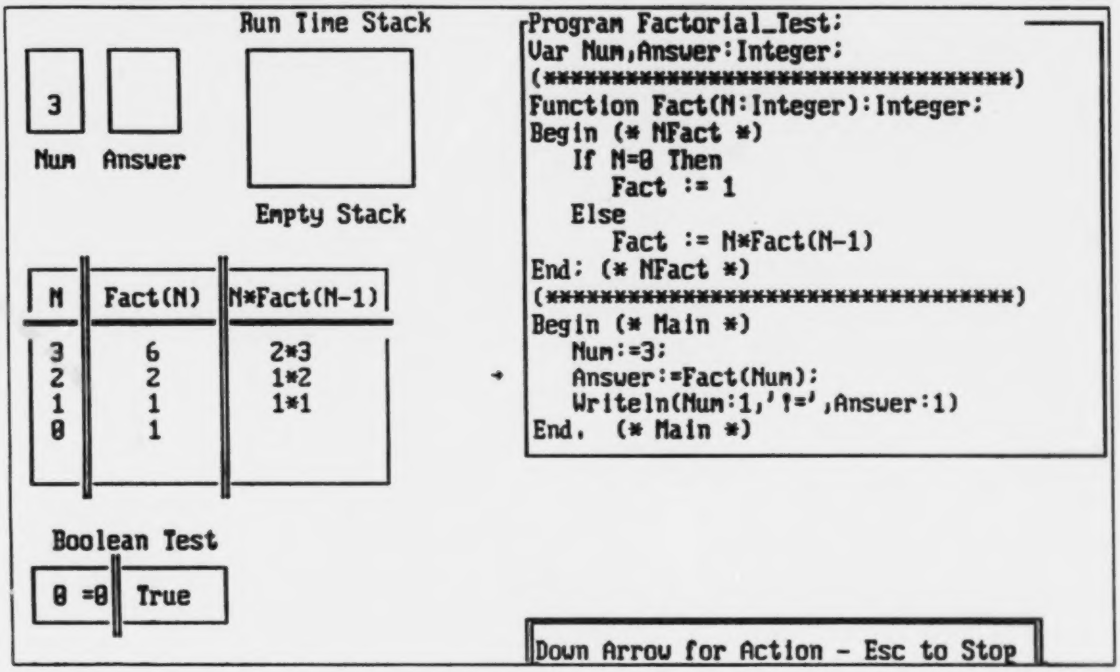
Figure 2


Run Time Stack
Fact(0)
Fact(1)
Fact(2)
Fact(3)
←Top
3
Num
Answer
→
Action Push
Boolean Test
0 =0
True
Down Arrow for Action - Esc to Stop

N	Fact(N)	N*Fact(N-1)
3	?	3*Fact(2)
2	?	2*Fact(1)
1	?	1*Fact(0)
0		

```
Program Factorial_Test;
Var Num,Answer:Integer;
(**********************************)
Function Fact(N:Integer):Integer;
Begin (* NFact *)
   If N=0 Then
      Fact := 1
   Else
      Fact := N*Fact(N-1)
End; (* NFact *)
(**********************************)
Begin (* Main *)
   Num:=3;
   Answer:=Fact(Num);
   Writeln(Num:1,'!=',Answer:1)
End.  (* Main *)
```

Figure 3


Run Time Stack
Num
Answer
Empty Stack
Boolean Test
→
Down Arrow for Action - Esc to Stop

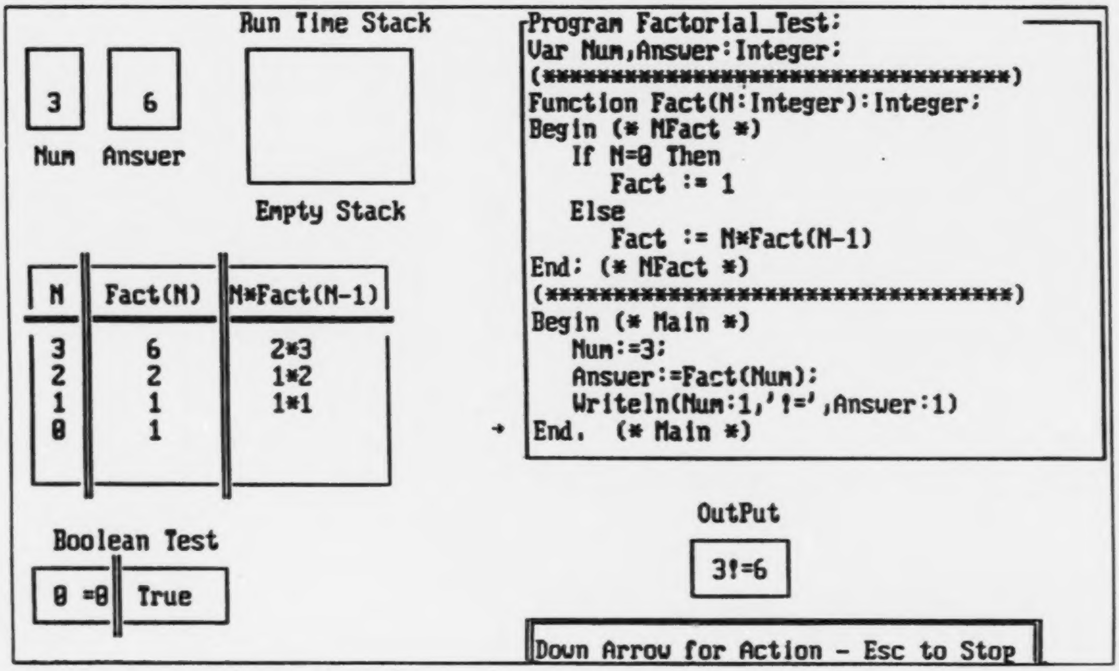
3

N	Fact(N)	N*Fact(N-1)
3	6	2*3
2	2	1*2
1	1	1*1
0	1	

0 =0 True

```
Program Factorial_Test;
Var Num,Answer:Integer;
(**********************************)
Function Fact(N:Integer):Integer;
Begin (* NFact *)
   If N=0 Then
      Fact := 1
   Else
      Fact := N*Fact(N-1)
End; (* NFact *)
(**********************************)
Begin (* Main *)
   Num:=3;
   Answer:=Fact(Num);
   Writeln(Num:1,'!=',Answer:1)
End.  (* Main *)
```

Figure 4


Run Time Stack
Num
Answer
Empty Stack
Boolean Test
→
OutPut
Down Arrow for Action - Esc to Stop

3
6

N	Fact(N)	N*Fact(N-1)
3	6	2*3
2	2	1*2
1	1	1*1
0	1	

0 =0 True

```
Program Factorial_Test;
Var Num,Answer:Integer;
(**********************************)
Function Fact(N:Integer):Integer;
Begin (* NFact *)
   If N=0 Then
      Fact := 1
   Else
      Fact := N*Fact(N-1)
End; (* NFact *)
(**********************************)
Begin (* Main *)
   Num:=3;
   Answer:=Fact(Num);
   Writeln(Num:1,'!=',Answer:1)
End.  (* Main *)
```

```
3!=6
```

Figure 5

Projects (W3-07)
Technology in Teacher Education

Computerizing a College of Education and Allied Professions

Gregg Brownell, Ron Russell, Char Scherer, Mike French , and Kathy Farber
College of Education and Allied Professions
Bowling Green State University, Ohio

Abstract

In the Fall of 1989, a College Computing Committee was formed in the College of Education and Allied Professions at Bowling Green State University. The charge of the committee was to investigate 1) establishing a series of Local Area Networks within the College for the purpose of providing faculty with personal workstations, electronic mail, access to a College-wide data base, University data, networks such as Bitnet, and laser printing capabilities; 2) devising a plan for upgrading facilities for the use of computers within the College for instructional purposes and; 3) forming an administrative computing network utilizing the University's Vax system. This presentation will summarize the committee's successful efforts in 1) writing and having accepted the first College-wide, comprehensive computing plan at Bowling Green State University; 2) obtaining initial funding for the plan, and 3) implementing the plan beginning in the summer of 1991. Copies of the committee's report will be made available to session participants.

Integrating Technology into a Teacher Education Program

Marcia Cushall
Frostburg State University
Frostburg, Maryland

Abstract

Abstract not available at press time

Integrating Technology into Teacher Education: A Project Report

Neal B. Strudler
University of Nevada, Las Vegas
Las Vegas, Nevada

Abstract

This project presentation will report on efforts to integrate computer-based technology throughout our teacher education program. The project has been supported by a Teacher Preparation Grant from the IBM Corporation with additional resources provided by the College of Education. The model for change that we have adopted is based on research on successful implementation of innovations in education including the need for various faculty members acting in change agent roles. An implicit assumption of this model is that our long range goal of integration of technology involves a substantial change in practice for many faculty members and will therefore be difficult to attain. Our approach has been to begin with faculty members who are open to increased use of technology, support their efforts, work to establish a critical mass of involved faculty, and eventually institutionalize curricular changes.

One component of this model involves my work as the coordinator of the project. Similar to effective technology coordinators at the K-12 level, I have attempted to employ a variety of product- and client-centered strategies to facilitate computer use. These strategies include obtaining necessary resources, providing training and follow-up support, organizing lab facilities, energizing and motivating faculty, collaboratively helping faculty to find computer applications that "fit" what they do, and gradually "weaning" faculty of their dependence on the coordinator. Effective strategies must take into account the "plight" of a faculty that is burdened with numerous existing responsibilities.

At the curricular level, we have found the need to better articulate and sequence computer experiences and skills developed throughout our program. Currently, students elect to take the required educational technology course at various stages in their undergraduate program. As a result, efforts to integrate technology into subject area methods courses have produced mixed outcomes. While some students are prepared to explore curricular applications of technology and extend what they've already learned, others have no foundation from which to build. Our undergraduate elementary faculty has therefore endorsed a proposal to make the educational technology course a prerequisite for all methods courses. It is the faculty's hope that by placing this class at the beginning of the program, students can then integrate technology into subsequent courses and field experiences. A key component of this proposal is the availability of the program coordinator to work with participating faculty on an on-going basis.

While the goal of integration will be extremely difficult to implement, we believe that it is a critical one if instructional technology is to realize its potential as an educational innovation. This project report will focus on our efforts toward achieving this goal as well as obstacles encountered in the process.

Project TEAM: Collaborative Technology Inservice for Teachers, Administrators, and Professors

Neal Grandgenett and Robert Mortenson
University of Nebraska, Omaha
Omaha, Nebraska

Abstract

Project TEAM (Technology in Education Advancement Model), was an extended inservice program that involved selected teachers, administrators, and university professors within the Omaha, Nebraska area. Participants were trained in both basic and advanced topics in educational technology, through awareness, experience, and integration related training activities. Instructional content included such basic topics as the use of wordprocessing, databases, and spreadsheets, and such advanced topics as artificial intelligence, grant writing, and research. Participants were also required to develop a long range integration project, which would impact their particular professional setting. Project participants were encouraged to cooperate with local educators in the development of their individual projects, and in finding solutions to common problems in their professional environment. Evaluation of the project was comprehensive and included systematic testing, personal logs and evaluation by an outside consultant. Formal analysis determined that collaborative inservice is an effective way to build expertise in educational technology and to help integrate technology into the classroom.

Special Presentation -ASCUE (W3-08)

Ethical Concerns and the Teaching of Values in Computer Science

R. Waldo Roth, Chair
Taylor Univeristy
Upland, Indiana

Mary Connolly
Saint Mary's College
Notre Dame, Indiana

Abstract

Two experienced college teachers will discuss techniques, methodologies, and case studies they have used in computer ethics and other computer science and computer literacy courses. These cases and experiences should be relevant and appropriate for teaching students at any level from middle school through adult education. There will also be a brief report on the first N.S.F. sponsored National Conference on Computing and Values, held in August, 1991. Audience participation will be encouraged and information on resource materials will be provided.

Special Presentation- ADAPT (W3-09)

An Overview of the Texas Assistive Technology Program

Abstract

This awareness level presentation by assistive technology specialists from Education Service Centers Regions VIII, XI, XII, and XVI will explain the following areas of the Texas Program for Adaptive/Assistive Devices:

- Mission Statement of the Program
- Definition of Adaptive/Assistive Technology
- Categories of devices from light tech to high tech
- Demonstrations of computer peripherals (including, but not limited to Expanded keyboard, Powerpad, Muppet Learning Keys, Adaptive Firmware Card and ECHO card)
- Summary of the Interdisciplinary Team Approach encouraged by the program for staff development

Handouts to be provided for each participant with a question and answer period allotted at the end of the session.

Presenters:

Cindy Shioleno, A/AD Specialist
Education Service Center, Region XI
Fort Worth, Texas

Barbara Predicke, A/AD Specialist
Education Service Center, Region XII
Waco, Texas

Connie Rymes, A/AD Specialist
Education Service Center, Reg. VIII
Mt. Pleasant, Texas

Max Hudson, A/AD Specialist
Education Service Center, Region XVI
Amarillo, Texas

Projects (W3-10)
Telecommunications in the Elementary Classroom

Mac Kids–Now What?

Susan Gordon
Hardin-Jefferson Independent School System
Sour Lake, Texas

Abstract

In the fall of 1990, I was introduced to a method of teaching that, for me, would soon become a major milestone in my teaching career. I had always been proud of my innovative methods of teaching. Exploring gifted and talented education was a natural direction for me. But now, I had a means to teach my curriculum so that my students, as well as myself, could explore the world outside our classroom.

Telecomunications opened these doors to creativity, innovative learning, and a fantasy world. My students learned that not all children went to school in a small rural school system. Not all schools had a state champion basketball team or a warm and nurturing school system as we do. The students at Sour Lake Elementary began to explore other parts of the United States. We participated in a project with students in Louisburg, North Carolina. We named ourselves MAC Kids. My students researched areas from the most popular toys for Christmas to what we do with our trash. The students in North Carolina did the same and eventually we traded information via the computer. What wonderful insights we gained through our experiences! All year we traded projects and information about ourselves and our community. Finally, toward the end of our school year, the two classes filmed their communities, their school, and themselves! Now we could actually *see* our new friends!! As a result, the popularity of our G/T program has greatly increased!

Getting Started With Telecommunications in Elementary Schools

Angela Mielke
Elgin, Texas

Abstract

Abstract not available at press time

Kid Link: Telecommunicaitons in a Global Community

Virginia Lawson
Luling, Louisiana

Abstract

Abstract not available at press time

Closing the Distance

Sue Nipp-Horn
Sand Springs Public Schools
Sand Springs, Oklahoma

Rhonda Layman
Duncan Public Schools
Duncan, Oklahoma

Abstract

Telecommunications via the computer, a modem, and a telephone line (also called data communications) has been a way that many teachers have extended the traditional classroom to allow their students and themselves to share ideas and information with others in remote locations. Over the past several years, teachers have begun to discover the potential for using educational telecommunication learning activities in their classrooms. Telecommunications learning activities, also commonly called telecommunications projects, are being conducted by teachers and students across the nation using a variety of commercial and non-commercial telecommunications networks.

Telecommunications projects potentially can change the functional learning environment. This promises to expand the traditional classsroom for both teachers and students. During the 1990-1991 school year, a "Picnic Project" and a "Cookbook Project" was offered over the FrEdMail Network (non-commercial) for grades 3-6. Participating students were able to explore the relationship between mathematics, geographic locations, and the availability of foods and related products. Students used a variety of tools to reason, make connnections, solve problems, and communicate mathematically. This project was offered as part of a dissertation study at Oklahoma State University.

During both projects special education students in Sand Springs, OK were given the opportunity to participate in an exchange of information with other students in grades 3-6. Although the activities were modified for these students, the project served to enhance the functional learning environment for these students.

Session participants will be given an overview focusing on the projects activities. Also, the adaptations made for the participating special education students will be highlighted.

Projects (W3-11)
Staff Development

Managing Staff Development with a Relational Database

Raylene Renfrow
Huntsville, Texas

Abstract

Abstract not available at press time

Telecommunications and Teacher Induction

Sally Turlington
Huntsville, Texas

Abstract

Abstract not available at press time

Trainers of Teachers (TOT) Steps to Literacy in the Northside I.S.D.

Janet McCormick
Northside Independent School District
San Antonio, Texas

Abstract

In the summer of 1991, Northside I.S.D. implemented a three phase staff development program that would offer the opportunity for all district staff members to become active computer users. This new program provided for appropriate staff development at the local campus level by trained teachers. A survey was given to determine the types and levels of technology staff development needs within the district. Phase I schools were chosen to be the first sites for the program. District level trainers (DLT's) designed and carried out the training modules for those teachers who would provide the inservice at the campuses. These campus teachers, Called TOT's (Trainers of Teachers) became part of the campus level support for technology. TOT's provided twenty-four hours of inservice tailored to their campus needs. The program has been well received and schools are looking forward to the next phase.

Educating Teachers to Use Technology as Part of Their Curriculum

Cynthia Conti
Durham, New Hampshire

Abstract

Abstract not available at press time

Projects (W3-12)
Information Technology in the Netherlands: From Project Initiation to Total School Commitment

Ton Diepeveen and Pieter Hogenbirk
PRINT (Project for the Implementation of New Technologies

Betty Collis and Gerrit Carleer
University of Twente

Pieter de Vries
University of Leiden

Tineke Zeelenberg and Bram van Weering
SLO (National Institute for Curriculum Development)

Abstract

In this session we will examine the process of implementation of technologies into school practice in The Netherlands. In particular, we focus on the progression from treating technology as a "special project" to the position in which technology becomes integrated into the everyday life of the school and teacher. We examine this progression from different perspectives: that of the national leadership to stimulate new technologies in education, that of the educational software developer, that of the teacher trainer, that of the curriculum developer, and a perspective involving one of the new technologies itself– telecommunications. In each case we see an evolution from well-planned central support of a "special project" toward system–wide integration and school-based initiatives. The examples we consider include those mentioned briefly in the Spotlight Session, "Going Dutch, By Satellite." In that session, the intention was simply to give an overview of activities in The Netherlands. The purpose of this session is to look more reflectively on the evolution of our experiences.

The Perspectives

1. National Leadership

In the Netherlands we have had a number of centrally established initiatives for the national stimulation of the use of information technology in Dutch education. The PRINT Project (1989-1992) is a four-year initiative of this sort. We will look briefly at the strengths of a national stimulation project, and will also discuss why the balance in The Netherlands is now moving toward school based partnerships and initiatives. As a special example of the projects being executed under the PRINT framework, we will look more closely at the "Proefstation" project, involving a four-year examination of what happens throughout a school when support is given to the integration of technology in every aspect of school practice.

2. Software Developers

Educational software development has been subsidized by the government in The Netherlands, but always with an orientation to partnerships with the educational community and commercial educational publishers. The PRINT and the POCO Project are large-scale national software development projects of this sort. We will look at the strategies that are evolving for the transition between nationally supported projects such as POCO and PRINT and a situation oriented among school-based demand with respect to the development and distribution of educational software.

3. Teacher Trainers

In The Netherlands the contents and funding of in-service training will, in the near future, no longer be centrally led and managed, but will be funded and determined in contents by the special needs of schools. On the basis of a total school commitment schools will establish their own policy. As a result the in-service training institutes have to face an increasing demand for more flexible education and new forms of training. We will look briefly at the strategies that are evolving to meet the special demands of school-based partnerships and initiatives.

4. Curriculum Developers

In The Netherlands there is a National Institute for Curriculum Development (the SLO) which has been involved in many of the national initiatives to stimulate the use of technology in education. How to integrate this use within the curriculums of "traditional" subjects is a major focus of the work of the SLO in this area. We will briefly examine the evolution of "technology as a special project" to "technology integrated within traditional curriculums" from the perspective of professional curriculum developers, with "COMPUTERJOURNAAL" as a particular example.

5. Technology Specialists

Finally, it is interesting to look at the evolution of technology use from special project to total school integration from the perspective of specialists in a particular technology itself. Our example here will be tlecommunicaitons. We will examine the evolution of telecommunications use in The Netherlands, from isolated special short-term initiatives to provision for ongoing support and service. Examples from earlier projects as well as current practice relative to the ongoing support of teachers through special resources for teachers, both off-line and on-line, will be discussed.

Conclusion

From each of the above perspectives, we will note the challenges of making the transition between the "special project" approach for stimulating the use of new technologies in education toward that of nurturing technology integration within ongoing practice. We note particulary the implications of moving toward an integrated approach centered on the needs and commitment of the school itself–what does this evolution mean in terms of national leadership, software development, teacher training, curriculum development, and new technologies such as telecommunications (whose effective use requires a significant prior investment in resource/infrastructure development and support) when more and more initiative is given to schools? What are the new opportunities and how can we apply what we have learned from the "special project" approach to an integrated, school-centered orientation for new technologies in education?

Projects (W3-13)
Multi/Hyper Media: K-12

Using Multimedia Technology to Accomplish a Native American Perspective

Doreen Bailey and Albenita Moquino
Santa Fe Indian School
Santa Fe, New Mexico

Abstract

Santa Fe Indian School is a grade seven through twelve boarding school for Pueblo, Navajo and Apache students operated by the Nineteen Pueblos of New Mexico. 1990 was the hundredth year of the school. In the past Santa Fe Indian School curriculum reflected the attitudes and beliefs of the larger society toward Indian education. At the beginning of this decade, the school began to redefine education from an Indian perspective. The five projects to be presented at the conference illustrate how contemporary communication technologies (desktop publishing, interactive multimedia, slides, audio tapes and video) were used to emphasize a Native American perspective in social studies.

Pieces of Our Past: Core (English, Social Studies and Reading) classes consulted pictorial, recorded and transcript archives of the history of Santa Fe Indian School, interviewed elders and used books covering the period in question to create an interactive, multimedia data base exploring our schools' history.

Painters of the Past: Seniors collected slides from museums and archives, interviewed elders and researched specific artists, to create a slide show and catalog honoring well known artists who attended SFIS.

Coloring Book: Students researched items of material culture that were exchanged as a result of the Columbian encounter and its aftermath. They summarized the origin of the item, its use and its impact on world culture then entered that information into a HyperCard template. One student illustrated the items to distribute the information in coloring book format to elementary children.

Pre-1492 Pamphlet: Social studies classes researched pre-1492 cultures in the Western Hemisphere and described how the Europeans arriving later depended on these cultures to survive. Using desktop publishing they produced illustrated pamphlets on each culture.

Map Rap Video: Using the model of the GTV laserdisc Map Rap, which depicts the growth of the USA across the continent in a modified MTV format, students wrote, illustrated, performed and taped raps describing the growth of the US from the Indian point of view.

HyperCard Stacks: Gifted 12th Graders Create; K-4 LD Students Learn

Eileen Boyle Young
Spalding University
Louisville, Kentucky

Abstract

The Disabled Citizens Computer Center of Louisville, Kentucky, a project of the Council for Retarded Citizens of Jefferson County, Kentucky is a charter member of the Alliance for Technology Access, and serves as the Western Regional Center for the Kentucky Assistive Technology Service Network. In May 1990, with the help of a National Science Foundation Grant, the Center opened a satellite Research and Development Lab at Spalding University in Louisville. This presentation addresses the work of that Lab during the last year.

The primary work of the Lab remains teaching gifted high school students to design and develop HyperCard stacks for students with disabilities. The goal of this project is to orient gifted/talented high school students to the basic instructional approaches appropriate for learning disabled individuals. Then these high school students can create acceptable HyperCard programs designed to assist the learning disabled person in the mastery of basic math skills.

Through the Alliance for Technology Access Centers, the HyperCard stacks are being evaluated and revised. In addition to the mathematics material for Learning Disabled students, The Lab has created informational stacks on the Americans with Disabilities Act of 1990. Copies of the stacks are available.

Elementary Students Create Their Own Software with HyperStudio

Barbara Falls
San Francisco, California

Abstract

Abstract not available at press time